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THE

TOUR OF MONT BLANC

AND OF MONTE ROSA

BEING

A PERSONAL NARRATIVE, ABRIDGED FROM THE AUTHOR'S "TRAVELS IN THE ALPS OF SAVOY," &c.

BY JAMES D. FORBES, D.C.L., F.R.S.

SEC. R.S. ED., F.G.S., &c.

Corresponding Member of the Imperial Institute of France, Associate or Honorary Member of the Bavarian Academy of Sciences, of the Academy of Palermo, of the Dutch Society of Sciences (Haarlem), of the Helvetic Society, of the Pontifical Academy of "Nuovi Lincei" at Rome, and of the Natural History Societies of Heidelberg, Geneva, and Vaud; Honorary Member of the Royal Medical Society of Edinburgh, of the Cambridge, Yorkshire, St. Andrews, and Isle of Wight Philosophical Societies, and of the Plymouth and Bristol Institutions, and PROFESSOR OF NATURAL PHILOSOPHY IN THE UNIVERSITY OF EDINBURGH.

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The Map of the Mer de Glace of Chamouni and neighbouring district, reduced considerably from the former Editions, has received very important additions and corrections from my own more recent observations. I still look forward to publishing it on a larger scale, and with more details.

The Introductory Chapter on Glaciers and their Scenery is principally extracted (by the kind permission of the Proprietors), from an article in the Edinburgh Review by the present writer, published some years ago.

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* This Chapter ought to have followed Chapter V. It is referred to at p. 92, *note*, being extracted from "Norway and its Glaciers, &c."

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INTRODUCTORY SKETCH

OF

GLACIERS AND THEIR SCENERY.

As the present volume contains a description of many glaciers, particularly those of the Chain of Mont Blanc, and consequently refers with more or less detail to many of the aspects of these astonishing elements of Alpine scenery, I have thought that it might conduce to the interest and utility of the work to prefix a strictly popular account of what glaciers really are, and what are the leading features of their class. Tourists are often so entirely taken by surprise when they see a glacier for the first time, and find it altogether different from what they expect, that they are completely bewildered, and afterwards regret not to have noticed the points most worthy of attention.

What is a Glacier?

When we approach a chain of mountains whose tops are constantly covered with snow, their acclivities green, and their bases clothed with wood, we should

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naturally expect to find a tolerably well marked line fixed by the level at which the snow never completely melts. Now this is very rarely, if ever, the case. The zones marked out by the limits of growth of particular plants, the superior limit, for instance, of the chestnut, the beech, or the pine, are generally more clearly defined than the level of perpetual snow. This is soon found to be due, in a great measure, to the forms of the mountain sides, in whose hollows the snow of winter by accumulating resists the summer's heat, which, had it lain only to its *average* depth, must infallibly have caused it to disappear. Such cases occur even in climates where glaciers, properly speaking, are never found. The highest mountains in Britain, for instance, those on the boundaries of Aberdeenshire and Inverness-shire, occasionally retain a portion of the winter's snow on their shady sides during the entire summer, without exhibiting any approach to the structure of a glacier.

A glacier, in the customary meaning of the term, is a mass of ice, which, descending below the usual snow-line, prolongs its course down the cavity of one of those vast gorges which furrow the sides of most mountain ranges. It is better represented by a frozen torrent than by a frozen ocean. Any one placed so as to see a glacier in connection with the range from which it has its origin, at once infers that it is, in some sense or other, the outlet of the vast snow-fields which occupy the higher regions. It is impossible to doubt that it results from, and is renewed by the eternal ice-springs of those riverless wilds. None who has ever seen or

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even clearly conceived a lava-stream, can fail to find in it the nearest analogue of a glacier. Stiff and rigid as it appears, no one can doubt that it either flows or once has flowed. Were the glacier like the flood of molten stone, the result of one great eruptive action, then its existence beneath the limits of the general snow line would be inexplicable. It melts—it must melt; it lies on warm ground yielding crops perhaps within a hundred yards of its lower extremity; the sun beats perpetually upon its icy pinnacles, which, though they reflect much, must retain some of the incident heat; and we see, accordingly, in a summer's day, the glacier oozing out its substance from every pore—above, beneath, within. And yet with all this the glacier wastes not; always consuming, it is never destroyed. Evident, therefore, it must be upon this ground alone, that a glacier glides imperceptibly down its valley, and this independent of all direct measurements of its motion. These, as we shall presently show, fully corroborate the inference.

The glacier therefore moves progressively, or, if the reader pleases, it *flows*. The flood of water of the arrowy Rhone passes so swiftly, that the passenger almost giddily follows with his eye the bubbles which mark its flight—the lava stream must be watched for some seconds or minutes, perhaps hours, to mark its progress—the stately march of the glacier is yet a stage more slow; months and even years are but the units of division of its dial.

But what is its dial? To answer that question, we must describe the configuration of the ice, which differs

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considerably from that of ice under most other circumstances. The lower extremity of a glacier, where it terminates in the valley, is almost always abrupt; sometimes so steep as to be nearly inaccessible, presenting a continuous rampart, from the base of which, through a vault deep in the mass of ice which hangs in half fallen fragments from the green roof, issues a turbid river partly the produce of the melting ice, and partly, no doubt, of the springs which rise under the glacier as elsewhere, and which give a certain volume to this stream even in the depth of winter. At other times the glacier rises from its very base in isolated jagged pinnacles, fissured in every direction, and absolutely inaccessible. This is commonly the case where the glacier terminates at the *embouchure* of a ravine, where it is very steeply inclined; the former character prevails more where the limit of the glacier is determined by its gradual descent into the warmer regions of a very gently sloping valley. There is yet another distinction between the terminal appearances of glaciers; and it is one of the most striking to the eye of the intelligent traveller. If the ground beneath the precipice of ice be covered with the debris of rocks discharged from the upper and lower surfaces of the glacier; if the vegetation be scanty and feeble, and great surfaces of rock lie exposed without a trace of soil or even lichen, as if some crushing mass had lately ground down its naturally uneven surface, then is the glacier in a diminishing or retreating state: the waste of ice below is not compensated by the supply above, and the retreat

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will continue until the diminished waste corresponds to the actual supply, by the progressive movement of the ice. If, on the other hand, the termination of the glacier touches the grass or cultivated land without much intervention of scattered blocks—if we see lying by its edge the trees which have been torn up, or cut over in its former progress—if the green sward is not only torn by the insinuation of the icy ploughshare, which is kept by its enormous weight in contact with the subjacent rock, but is likewise wrinkled into ponderous folds far in advance of the glacier front—there we have plainly proof of the excess of the supply above the waste—the glacier is in progress.*

Now, suppose the first difficulty of ascent overcome, and that whether by choosing the less steep parts of the abrupt face, or by following the line of rocky masses which the glacier rolls down, and of which it forms a girdle, extending from side to side—or lastly, by climbing the walls of the valley itself in which the glacier lies, we have reached the upper surface of the ice. We then see, what so many have seen from the Montanvert at Chamouni—a gently sloping icy torrent from half a mile to three miles wide, more or less undulating on its surface, and this undulating surface more or less broken up by *crevasses*† which, generally nearly ver-

* In the year 1818, the front of the glacier of the Rhone advanced 150 feet.

† The translation of the French word *crevasse* into the English *crevice*, is so evidently inapplicable to these vast fissured chasms, that we shall constantly adopt the French spelling.

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tical in their direction, have a width of from a few inches to many feet or fathoms, and a length which sometimes extends almost from side to side of the glacier. In all this, there is little or no resemblance to water tranquilly frozen. The surface is not only uneven but rough, and the texture of the ice wants the uniformity of that formed on the surface of lakes. The hollows, which appear but trifling when viewed from a height, and compared with the expanse of ice, are individually so great as to render the passage amongst them toilsome in the extreme, even independent of the crevasses; and the traveller who has to walk for several hours along a glacier will often prefer scrambling over stones or rocks on the side, to the harassing inequalities which appeared at first so trivial.

In a day of hot sunshine or of mild rain the origin of the hummocky ridges is apparent: the intervening hollows have every one of them their rill, which, by a complicated system of surface draining, discharge the water copiously melted by the solar influence, the contact of warm air, and the washing of the rain. These rills combine and unite into larger streams, which assume sometimes the velocity and volume of a common mill-race. They run in icy channels excavated by themselves, and, unlike the water escaping from *beneath* the glacier, being of exquisite purity, they are both beautiful and refreshing. They seldom, however, pursue their uninterrupted course very far, but reaching some crevasse or cavity in the glacier mechanically formed during its motion, they are precipitated in bold cascades into its

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icy bowels; there in all probability to augment the flood which issues from its lower termination. Nothing is more striking than the contrast which day and night produce in the superficial drainage of the glacier. No sooner is the sun set, than the rapid chill of evening reducing the temperature of the air to the freezing point or lower—the nocturnal radiation at the same time violently cooling the surface—the glacier life seems to lie torpid; the sparkling rills shrink and come to nothing; their gushing murmurs and the roar of their waterfalls gradually subside; and by the time that the ruddy tints have quitted the higher hill-tops, a death-like silence reigns amidst these untenanted wilds.

Winter is a long night amongst the glaciers. The sun's rays have scarcely power to melt a little of the snowy coating which defends the proper surface of the ice;—the superficial waste is next to nothing; and the glacier torrent is reduced to its narrowest dimensions.

Moraines.

Pursuing our survey, we next notice the bands of fragmentary rocks which traverse the glacier in nearly parallel lines—sometimes confined to its edges, sometimes dividing its breadth into two compartments so distinct that we can hardly help fancying that we see two glaciers, separated by a vast mound of blocks which rise from the bottom of the valley.

The slightest examination shews that these accumulations of debris (to which the name of MORAINES has

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been given), are perfectly superficial, and conform themselves so entirely to the configuration of the ice-surface, that on many glaciers scarcely one stone lies upon another, every one covers the ice immediately. Thus, on the Aar glacier, where the ridge of stones seems to form a heap, or rather two parallel heaps, upon the level ice, it is found that the ice itself is heaped up under the stones, and gives the entire form to this sort of backbone, which divides the surface into two nearly equal parts, rising in some places to a height of eighty feet above its general level. So irreconcileable are the facts with the theory formerly adopted of these moraines, that they were stones which, having fallen on the sides of the glacier, gradually settled down upon the centre, as being its lowest part.*

As a general fact, it may be stated, that every glacier has two moraines at least, composed of the masses which, detached by gravity, aiding the effect of moisture, and the freezing of water in the cracks of the neighbouring rocky heights, fall on the edges of the glacier, and form two borders, or *selvages*, which accompany it, generally speaking, throughout its entire length. These are called *Lateral Moraines*. Besides these, there are the parallel bands of debris which divide the glacier in the direction of its length, and of which we have just spoken. There can be no question that the origin of these has been, for the first time, correctly stated in the works of Charpentier and Agassiz. But this brings us back again to the movements of the glacier; for these mo-

* Saussure, *Voyages dans les Alpes*, § 537.

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raines are the divisions on the dial of which we have above spoken, and upon which we read the chronology of glacier history. A simple statement of facts will at once illustrate and prove this.

The higher parts of glaciers are always contained in valleys extending above the limits of vegetation; and, indeed, the walls or sides of these ravines are extremely precipitous in most cases, so that even the snow covers them imperfectly. The exposed rocks are subject to great changes of temperature, owing to the intense effect of solar radiation at these heights. The snow in contact with their surfaces is melted almost every summer's day, and the moisture is absorbed into the minute fissures of the stone. The nocturnal frosts congeal this water, and the powerful expansion thus occasioned has the effect of loosening and disintegrating the hardest rocks, in a manner which has no parallel under other circumstances. Atmospheric causes, therefore, produce their maximum of destructive effects in the neighbourhood of glaciers; and, as a matter of course, the detached fragments, descending by their weight, often rebound from cliff to cliff, until they fall shivered into smaller morsels upon the surface of the ice. Such an *eboulement* leaves a distinct proof of its occurrence by the heap of rubbish resting on the glacier. If *this* had no progressive motion, the fragments would remain piled under the rock whence they fell; until, perhaps in the succeeding spring, being joined by another group, they would accumulate at those points where the bounding rocks were, by their nature or position, most liable to the

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recurrence of these events. If, however, the glacier flows on in the interval, the previous mass of *debris* has been carried some distance downwards on the surface before the second fall took place; and thus, supposing only one discharge of fragments annually, the movement of the glacier for each year would be marked by the spaces intervening between the successive heaps.

There is an instrument invented in France, for the measurement of minute intervals of time, in which, instead of a hand revolving upon a dial or ring, the dial itself revolves, and the hand remains fixed: this fixed hand is provided with a minute-dotting apparatus, by means of which the slightest pressure of the finger leaves imprinted on the white surface of the dial a small black point, thus marking, and permanently registering, the instant of the occurrence of the pressure by the position of the dial relatively to the fixed hand; and as this operation may be repeated any number of times during the revolution of the dial, there are as many marks as we please, whose intervals indicate the periods of their occurrence. Just so we find on the surface of the glacier, a dial, divided unequally by the fallen blocks, which, detached from one promontory of rock, or descending down one water-course, bear testimony to the intermediate motion of the surface on which they fall. It is evident, then, how a *moraine* is formed: it is the scattered accumulation of debris along a line whose length, reckoned from a fixed point, may be roughly considered as proportional to the time elapsed since their fall. To produce such a continuous mound of stones as

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we often see bordering a glacier in its whole extent, it is therefore not necessary (as we might at first sight suppose) that they should have fallen from every part of its walls; a single rock near its upper extremity may be the source of the entire lateral moraine or mass of fragments—lying partly upon the edges of the ice, partly on the slope or shore which bounds the glacier, and partly wedged between the ice and the soil.

Whenever the confluence of two glacier-branches occurs, there must be a union of the moraines which bordered the sides of the respective ice-flows. These moraines, carried forward by the progressive motion of the surface on which they repose, cannot stop short by their union with one another. They cannot be buried in the confusion which sometimes occurs at the confluence of the two glaciers, because (as we shall afterwards attempt to explain) the glacier throws to the surface any extraneous bodies enveloped in its mass: therefore the two moraines must unite and advance in the centre of the now united glacier stream. This united stream of superficial fragments is called a *medial moraine;* and is to be seen in greater perfection on the glacier of the Aar than, perhaps, anywhere else in the Alps. The two streams of blocks are never quite confounded, and for many miles along the united glacier may be traced the characteristic colours of the stones derived from one and the other parent branch. As a general rule, wherever a tributary ice-stream joins the main glacier (suppose on the *left* bank), it brings also its tributary moraines. Its *right* moraine joins the lateral moraine of the gla-

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cier, and forms a medial moraine, its left moraine being now the lateral one of the united glacier.

As these facts are important to be distinctly apprehended, some slight figures may tend to illustrate them. Thus, figure 1 represents a plan of an ideal glacier composed of five streams, A, B, C, D, E, each of which has

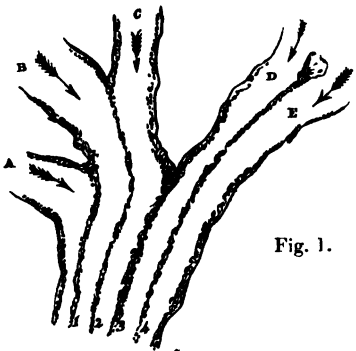
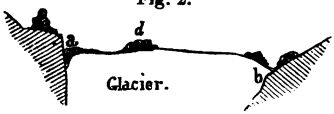


Fig. 1.

Fig. 2.



its lateral moraines, and the union of these represented by the dotted lines, 1, 2, 3, 4, forms the superficial trains of rocks which are carried along on the surface of the ice. A mere prominent rock or islet in the ice, as that between D and E, may yield also its small contribution of blocks. The section in figure 2 represents

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a glacier having a steep wall, *a*, where consequently the debris are ingulfed between the wall and the ice, producing friction, and an inclined shore, *b*, on which the lateral moraine has been deposited. There is also shown, at *c*, the position of an ancient moraine, deposited at a time when the glacier was elevated enough to have submerged the promontory *a*; one of the *medial moraines* is shown at *d*. The ice rises to a greater height under it than at any other part, owing to a circumstance to be mentioned immediately. An exact idea of the general phenomena of moraines will be obtained from the map of the Mer de Glace of Chamouni accompanying this work.

Motion of Glaciers.

From what has been said, it follows that the *direct* proofs of the movement of a glacier must be sufficiently numerous upon its surface. Any well-marked block having its position ascertained by a reference to a fixed object on the slope of the valley, will be found in the course of a year to have passed onwards. Saussure's ladder, left on the Glacier du Géant in 1788, was recognised by its fragments not many years ago on the lower part of the same glacier, not far above the Montanvert, having traversed in the interval, a space of 13,000 feet, or two and a-half miles. About 1830, M. Hugi attempted to measure the forward progress of the ice of the glacier of the lower Aar, by ascertaining in successive years the position of a conspicuous block on

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the medial moraine. The measurement was repeated later by M. Agassiz, but the results materially disagreed. In 1842, the writer of the present volume undertook observations on the Mer de Glace of Chamouni, not merely for ascertaining the annual, but even the *daily* motion of the ice, which was for the first time observed in June of that year. Subsequent observations of various kinds enabled him to fix the annual motion at various parts of this extensive and diversified glacier, and also its relative amount at different seasons of the year. Strictly scientific details have been carefully avoided in this work; but it cannot be without interest to mention the rate of motion of several different points of the Mer de Glace, the relative position of which may be found by a reference to the map, and to chapters VI. and VII. of this volume. They are arranged in an ascending order from the lowest point of the glacier:

	Eng. feet per annum.
Near the source of the Arveron, where the glacier has a small inclination, ...	223
Between the previous station and the Chapeau, where the glacier is steep, about 100 yards from north bank of glacier, ...	848
A little below Montanvert, 130 yards from west bank, ...	626
Do. do. centre,	876
Between Montanvert and "Les Ponts," near side,	486
Do. do. near centre,	823
At the "Angle" near the side, ...	482
Somewhat higher up near the side, ...	496

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	Eng. feet per annum.
"Pierre platte" C, on Glacier de Lechaud (mean of 8 years),	300
Glacier de Lechaud between the last and the Tacul,	328
Glacier du Géant towards centre,	413
Higher part of Glacier de Lechaud,	529
Exit of glacier of Talêfre towards the side,	432
Do. do. centre,	526

The motion varies at different seasons. It is less in winter than in summer; but even then the motion is very considerable.

This progressive movement of the ice towards the valley has been variously explained. The theory attempted to be deduced from the numerous experiments recorded in my former work (Travels in the Alps of Savoy, &c.,) is briefly this: that a glacier is, in truth, a sluggish stream moulding itself, notwithstanding the apparent hardness and fragility of the ice, over the inequalities of its bed and the irregularities of its confining banks, and retaining its coherence throughout, notwithstanding the numerous cracks by which its surface is fissured, in consequence of an inherent plasticity of its substance, which only become sensible under intense and long-continued pressure, producing a very slow motion. It will be observed from the preceding table that the velocity is much greater at the centre of the stream than at its sides, conformably to the laws of rivers.

What a curious internal historical evidence, then, does a glacier bear to the progress of events which

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have modified its surface. It is an endless scroll—a stream of time—upon whose stainless ground is engraven the succession of events, whose dates far transcend the memory of living man. Assuming, roughly, the length of a glacier to be twenty miles, and the velocity of its progression (*assumed* uniform) one-tenth of a mile, or 500 feet, the block which is *now* being discharged from its surface on the terminal moraine may have started from its rocky origin in the reign of Charles I.! The glacier history of 200 years is revealed in the interval; and a block ten times the volume of the greatest of the Egyptian monoliths which has just commenced its march, will see out the course of six generations of men ere its pilgrimage too be accomplished, and it is laid low and motionless in the common grave of its predecessors.

Glacier Tables and Cones.

When we come to study more carefully the arrangement of the rocky fragments and earthy matter upon the surface of the glacier, we find a multitude of curious details. One of the most striking is the occurrence of what are called *glacier tables.* These consist of masses of rock usually connected with one of the moraines, lying on their flat side, and supported above the general level of the glacier by an icy pedestal—a "pillar and claw" foundation. Now, this is not only a picturesque accident, but recalls our attention to a most important circumstance of the glacier economy—that

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there is a perpetual waste at its surface, and that the stone, by preventing this waste, remains an index of the former level of the whole mass, like the earth pillars left by workmen in the course of excavation. Though some authors have attempted to make the glacier tables on their stalks sprout like mushrooms from the surface of the ice, there cannot be a doubt that this is their real origin. A very simple experiment which has actually been made gives the direct proof. If a hole be made vertically in the ice, and a stick sunk into it, so as to rest upon the bottom at a depth of ten or twenty feet, it will be found that during summer weather the upper part of the stick becomes gradually bared by the dissolution and evaporation of the surface of the ice. A glacier has thus been found to lose a thickness of more than three feet in as many weeks. The action of the stone is very evident. The whole of its lower part is maintained by contact with ice at a freezing temperature; if the thickness be considerable, it forms a pretty complete shelter against the direct action of the sun's rays, as well as against the contact of warm rains and wind.* Thus the ice immediately beneath it is comparatively preserved. It is a clumsy but effectual parasol.

But yet we often find precisely the contrary effect wherever the ice is pretty consistent, so as to admit of pools of water being formed; *there* we have innumerable cup-shaped cavities, each containing a bit of slate, a

* The phenomenon of glacier tables was perfectly well explained by Saussure.—*Voyages*, § 630.

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dead insect, or not unfrequently a *leaf*—a leaf which assuredly could not have fallen from the sides of the glacier, which have not a single tree—but leaves even of the beech and chestnut are wafted by the tremendous violence of the winds from immense distances, and across elevated chains covered with perpetual snow.* Here, then, the presence of a foreign body has wasted, instead of protecting the ice. The difference lies merely in the thickness. The dark surface of the chip of stone or organised matter absorbs the solar heat, and transmitting it quickly to the ice, by being completely warmed through, excavates for itself a cavity. It is in these cavities, too, that living animals are often found —small black insects which inhabit the snow or ice-cold water, and there propagate their species.

Sometimes the ice is completely honeycombed by these cups, which often break into one another, and unite their contents; at other times the passage of the rills already mentioned accumulates sand and gravel, derived from the moraine, and so soon as this accumulation reaches a certain thickness, a surprising change takes place. The solar heat enters, but no longer freely penetrates the mass; the action of the extraneous matter becomes conservative; the ice melts more rapidly all round than under it; and, after a while, the face of the glacier *becomes precisely reversed*—the mould of what it was before. The heights take the shapes of the corresponding hollows; a crevasse filled with

* Such have been found on the upper glacier of the Aar, which must have been transported from the lower valley of the Rhone.

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sand becomes in time a ridge of ice, coated with the sand which formed it; we have negative water-courses, negative *crevasses*, negative holes. From what we have already said of the magnitude of the superficial water-courses, it will be conceived that the *detritus* which they bear with them may be abundant, and that it may be deposited in considerable quantity in the deeper excavations. But the result would hardly be anticipated, and indeed must be seen and watched in its various stages, to be well understood. As the protected surface rises higher and higher relatively to the general level, the sand which composes it falls, or is washed gradually down, protecting the sides of the icy cone which has been formed beneath it, to which (though continually streaming with moisture) it contrives to adhere with a tenacity not easy to explain. A glacier which, by the evenness of its surface and numerous water runs, is adapted for the production of this phenomenon, is thus covered with a number of gravel cones, whose regularity and magnitude astonish and perplex the observer. They may be seen from 15 to 20 feet high, and 70 or 80 in circumference. It is hardly possible to doubt at first sight that these cones (which are like enormous ant-hills) are composed, to the centre, of gravel; but we invariably find, as already stated, that it is a mere covering; the heart of the cone is *pure, solid ice*, which, if its apex be removed with a hatchet, appears quite black and glassy from the obstruction of the light by the sides of the cone.

These phenomena are important, as explaining how

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it is next to impossible that extraneous matter can become imbedded in the glacier. By retarding the superficial melting as soon as its mass has become at all considerable, such an accumulation of debris must sooner or later find its way to the surface—not by pushing through the matter of the ice, which some writers seem to suppose (as many of the peasants do) to be endowed with a sort of organic faculty of rejecting impurities—but because these impurities retain their place in the ice, which is continually thawing and evaporating by the surface; and, once arrived there, they can never, for the reasons already explained, again penetrate the mass, but will in general attain a level above it.

The appearances we are describing are not to be found upon all glaciers; the gravel cones especially are rare productions, and depend probably, in a great measure, upon two circumstances—a moderate slope of ice, which, not being greatly crevassed, permits considerable water-courses to be formed—and abundant *moraines* affording disintegrated materials for the accumulations in question. Such a glacier is that of the Lower Aar. The glacier of Aletsch, though abundantly flát, is destitute of considerable medial moraines—the glaciers of Chamouni are, for the most part, too precipitous.

Surface of Glaciers.—Travelling on the Ice.

When a glacier descends a steep mountain ravine like those of the Allée Blanche, which pour their majestic

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frozen torrents down the tremendous gorges which the chain of Mont Blanc presents on its southern side; or like the lower part of the glacier of Viesch in the Upper Vallais; or like the glacier of Rosenlaui, and that of Upper Grindelwald, in the canton of Berne, the condition of the ice differs considerably from that which we have described. Urged onwards in its flow upon the immense bed of rocks on which it reposes, forced sometimes to discharge itself over the bank of a precipice, the rigid mass is fissured in all directions. Swayed hither and thither by the unevenness of its base, the fissures maintain no constant direction, but subdivide the ponderous mass into rude, prismatic fragments, whose height is the thickness of the ice, and the form of their bases is determined by the meeting of the fissures which form them. These prisms become transformed into pyramids more or less rude by the action of atmospheric water, the contact of air and evaporation, which speedily sharpen their summits, rising in a thousand fantastic forms, whilst their bases, here and there irregularly cut through by the escape of glacier torrents, become excavated into not less fantastic labyrinths in the deep blue depths of the ice, which often preserves here its most characteristic purity. As the excavation proceeds, these pyramids, doubly acuminated above and below, topple over and increase the apparent confusion by mingling their ruins. The moraines with which the surface has been charged, are, as a matter of necessity, dispersed into every fissure by the discontinuity; and the masses thus fallen, and ground by the pressure of

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the ice, are from time to time rolled down the rocky steep, and finally are borne to a certain distance by the impetuous torrent which flows from its base. To make much way along such glaciers as these is, evidently, next to impossible. The experienced guide will either cross the glacier as directly as possible, if his course requires him to do so—(as in crossing the glacier of Bossons, on the ascent of Mont Blanc,*), or scale the rocky walls of the ravine in preference to attempting to follow the course of the glacier. Such excursions, even when not dangerous, are the most fatiguing of all sorts of climbing;—the traveller now leaping from point to point along the jagged edges of the ice which bound the fissures; now making long zig-zags to get round the *crevasses* which cannot possibly be traversed; at other times descending the walls of those less steep and profound, and laboriously climbing the opposite face. Or, if he prefer the moraine (where it exists) to the ice,

* Thus described by Mr. Auldjo:—"We were surrounded by ice piled up in mountains, crevices presenting themselves at every step, and masses half sunk in some deep gulf; the remainder, raised above us, seemed to put insurmountable barriers to our proceeding, yet some part was found where steps could be cut with the hatchet; and we passed over these bridges often grasping the ice with one hand, while the other, bearing the pole, balanced the body, hanging over some abyss into which the eye penetrated and searched in vain for the extremity. Sometimes we were obliged to climb up from one crag of ice to another; sometimes to scramble along a ledge on our hands and knees; often descending into a deep chasm on the one side, and scaling the slippery precipice on the other."—*Narrative of an Ascent of Mont Blanc*, 1827, *p.* 15.

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he must step from top to top of the curiously piled stones, which rest upon the ice, propped in the most fantastic positions, and, on account of the perpetual changes of their bed, not firmly jostled, as on solid ground, into positions of stable equilibrium, but often resting in such ticklish balance that his weight is sure to precipitate a host of them, and himself above all, down one of those treacherous slopes. Driven sometimes from all these modes of progression, there is no alternative but to scale the rocks which confine the glacier; which are generally so rugged, and intersected by water-courses, that a summit or elbow has no sooner with infinite toil been gained, than the traveller finds himself compelled to make a descent, still more difficult and alarming, to his old level. Such are the alternatives which not unfrequently present themselves to the glacier tourist—alternatives which Milton, in his enumeration of the difficulties which beset the Satanic voyage to earth, has failed to particularise, doubtless, (shall we say) from being unacquainted with them. Often is even the skilful mountaineer

> "——— harder beset
> And more endanger'd than when Argo pass'd
> Through Bosporus betwixt the justling rocks:
> Or when Ulysses on the larboard shunn'd
> Charybdis, and by the other whirlpool steer'd,
> So he with difficulty and labour hard
> Moved on; with difficulty and labour he.

There are, however, many glaciers whose ascent is attended with no such inconveniences and perils, al-

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though generally with some labour, whether along the moraine or on the ice; the cool footing, and the exhilarating mountain air give, however, an elasticity and confidence to the tread unknown below—the eye, familiarized with precipices, forgets their terrors, and those who at home would hesitate to walk along the top of a narrow wall, can look with unblenching gaze into the fathomless depth of the glacier *crevasses*. But whether the inferior part of the glacier has been steep and dislocated, or even and gently inclined, the higher portion of the ravine or basin in which it takes its origin is very generally, for some space at least, moderately flat. The glacier here bounds with the region of perpetual snows, from which (on every theory), it depends in some way or other for its sustenance and increase; and consequently this portion of the ice-field peculiarly demands our attention, for it presents important modifications; and, in fact, has received from mountaineers a peculiar name—in French it is called *Névé*, and in German, *Firn*.

The Névé or Upper Glacier.

The névé or firn is the unconsolidated glacier. As we approach it, the fissures of the glacier become generally rarer and always narrower. The elevation above the sea being already very considerable—perhaps 8000 or 9000 English feet, the winter's snow lies all summer on the surface of the ice, conceals the *crevasses*, and partly also the structure of the matter of the glacier

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itself; to discern which the snow must be carefully removed. It is a frequent, perhaps a general characteristic of the transition from the glacier proper to the névé, that whilst the former presents a *convex* surface, the latter is *concave*, and inosculates insensibly into the snowy steeps which clothe the sides of the upper glacier-basins at these great heights. Magnificent is the prospect which these firns sometimes present. The surface is smooth and almost level, like an artificial floor, stretched across a valley, whose sides evidently descend to a great depth beneath. It is a real platform—to compare great things with small, it is a theatre with the pit boarded over; and what a theatre! From that even, snowy carpet of dazzling white, rise hundreds of nameless peaks on either hand, seeming to pierce a sky whose azure hue is so intense as to find no match in nature, save the gentian, which expands its lovely flowers close to the glacier. The sides scathed by lightning, and torn by the avalanche, scarcely permit a resting-place for the snow, which accumulates in dazzling wreaths only in its sheltered nooks. Each of these pinnacles transported to an ordinary scene, would seem one of nature's grandest objects, but here it is lost amidst the crowd of its fellows. But a very few have any specific name, and still fewer are found indicated on the best maps. Sometimes the ice-field abuts abruptly against precipices which rise nearly vertically from out of it, as does the Finster Aar Horn from the névé of the Aar Glacier—a

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splendid surface, almost flat, and of many square miles in extent, in the midst of the very highest group of mountains in Switzerland proper.

The structure and consistence of this unconsolidated glacier is extremely remarkable. It is evidently snow in a transition state into ice, having a granular structure resulting from the partial thaw to which it has been subjected in consequence of the water which the heat of the sun produces, percolating pretty freely through the mass. The *crevasses* in the névé differ from those in the glacier by their greater width and irregularity, by their beautiful green colour, and by the horizontal stratification of the material forming their sides, which is divided by bands of more or less perfectly formed ice, corresponding, perhaps, to annual periods, or to extraordinary falls of snow. It is hardly necessary to say, that the passage from the glacier proper to the névé is graduated, not abrupt. It appears to have an intimate connection with the permanence of the winter falls of snow, which entirely vanish during summer upon the surface of the ordinary glacier, with which they never enter into intimate combination, but are melted by degrees; excepting here and there a mass which, falling into a *crevasse*, is there consolidated by successive thaws and congelations. The region of the névé or firn is one of intense and unmitigated desolation. Even where a rock appears, no plant more developed than a lichen or moss flourishes upon it; a stray insect is in general the only trace of animal life; even the chamois avoids these

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wilds unless pursued; no animal, indeed, can be more sensitively afraid of the *crevasses* and chasms which, thinly covered by treacherous snow, often reveal to the amazed traveller the awfully precarious footing upon which he has just heedlessly passed.

This portion of the glacier, occupying, as we have said, the upland basins or hollows which stretch far into the mass of compound mountain systems, is succeeded by the last member of the glacier series, which occupies the sides and summits of the mountain ranges themselves, and their innumerable offshoots. The *névé*, whose gently swelling concave form we have attempted to describe, generally terminates tolerably abruptly against some rocky or very steep icy boundary, by which the highest mountain summits or ridges are to be scaled. There is a chasm of separation so well marked and so general, as to be considered as forming part of the characteristic glacier type, and which is called in the German part of Switzerland the *Bergschrund*. The passing of this forms a very frequent and notable difficulty in the way of alpine travellers, who attempt to attain the highest regions. Once passed, the glacier features are resumed; on the flanks of the mountains, and even on their summits, the snow is consolidated into a compact icy structure, alternating, however, in the more sheltered places, with crisp snow, which separates the icy layers, characteristic also of the proper névé. That true ice should be found on the highest summits is not a matter of the least surprise to those who reflect that the sun acts at these eleva-

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tions with an intensity unknown below, and though the continued accumulation of snow is no doubt greatly prevented by the action of wind (which may often be seen driving to leeward a delicate cloud of dry snowy particles having all the appearance of the finest vapour),* and likewise by the *immediate* evaporation of the snow without passing into the liquid form; yet there can be no question that every hot summer's day proper fusion goes forward, and a corresponding congelation during the night, forming a true icy casing of the most insulated summits where snow can rest at all. De Saussure, indeed, was not convinced of this fact until he actually ascended Mont Blanc,† whose top, surveyed with the greatest care from the Cramont, he had previously‡ supposed to be merely snow. There are other mountains, however, which bear direct testimony to the fact, even from a distance. Some of the magnificent icy pyramids in the neighbourhood of the Ortler Spitz in the Tyrol, are evidently composed in their upper parts of pure ice, which, in certain positions of the sun, transmits its characteristic greenish light in a manner truly magical.§ A great number of mountains too, above 10,000 feet high, and having precipices on their northern or eastern sides,

* *Le Mont Blanc ume sa pipe*, say the Chamouniards.

† Voyages dans les Alpes, § 1981. See also Auldjo's Mont Blanc. ‡ Ibid. §§ 530 and 940.

§ It is probably, for this reason, that the Ortler obtains on the Italian side the name of Monte Cristallo. Captain Gerard mentions, that on the Himalaya the snow visibly melts during summer at heights exceeding 20,000 feet.

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present the following remarkable appearance:—Icy crusts, possessing great consistency, project *many feet* over the precipices, and when the sun shines favourably upon them, exhibit their peculiar colour with extreme delicacy. These projections are formed by the tufted accumulation of gently drifted snow, which, thawing at intervals, becomes invested with a crisp coating. This crust, if pierced inadvertently, may bring a traveller into the most perilous situations, or sacrifice his life. Hugi picturesquely describes one of the most awful positions of this kind in which a human being was ever placed. Whilst attempting the ascent of the Finster Aar Horn, he broke by his weight through a cornice of ice, such as we have described, only two feet thick, and projecting five or six feet over a sheer precipice of 4000. Fortunately one of his companions had for security a hold of the other extremity of a long staff which he carried, who applying his whole weight at the opposite end, the two were held suspended in awful equilibrium, as at the arms of a balance, until help was obtained.—(*Natur-historische Alpenreise*, page 193.)

Geological Agency of Glaciers.

As allusion is frequently made in the following pages to the geological evidence of the former extension of glaciers, which may even be believed to have covered at one time the entire plain of Switzerland, it may be proper here briefly to add, that this evidence of the former presence of a glacier is twofold—(1.) by the abra-

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sion which glaciers unquestionably exert by means of the gravel or powdered rock derived from its moraines, and which it carries abundantly along with it. This abrasion is shown by a peculiar and unnatural shaving off of the usual abrupt surfaces of rock, and the formation of peculiar grooves and scratches on the abraded surface. Such appearances are to be found not only beneath existing glaciers (see pages 30 and 127 of this volume), but in valleys far removed from the limits of perpetual snow, and even in countries entirely destitute of it. (2.) The second evidence of the extension of glaciers is found in the conveyance of huge blocks of granite and other rocks belonging to the central chain of Alps down to the very outskirts of the chain, and even across the plain of Switzerland to slopes of the Jura mountains, where gigantic masses lie often in very singular positions, whose presence can hardly be accounted for but by the unlimited carrying power of ice, as shown by the transport of moraines already described.

One of the most remarkable of these transported blocks of primitive rock is the "Pierre à Bot," which now lies on secondary limestone in the neighbourhood of Neufchatel, and of which a figure is annexed. Its dimensions are 50 feet long, 20 wide, and 40 high, containing 40,000 (French) cubic feet, transported 60 or 70 miles as the crow flies from its original bed in the chain of Mont Blanc.

A scarcely less striking instance (although the distance of transport is less) is found in the "Blocks of Monthey," not far from St. Maurice, in the valley of the

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Rhone, and in others near the town of Sion, which have been admirably described by De Charpentier. We cannot enter into farther particulars without extending

The "Pierre à Bot."

this notice too far, and entering into a discussion more or less technical. I shall therefore refer the reader who wishes more information to the third chapter of the "Travels in the Alps of Savoy," and to the authors there cited.

Conclusion.

Poets and philosophers have delighted to compare the course of human life to that of a river; perhaps a still apter simile might be found in the history of a

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glacier. Heaven-descended in its origin, it yet takes its mould and conformation from the hidden womb of the mountains which brought it forth. At first soft and ductile, it acquires a character and firmness of its own, as an inevitable destiny urges it on its onward career. Jostled and constrained by the crosses and inequalities of its prescribed path, hedged in by impassable barriers which fix limits to its movements, it yields groaning to its fate, and still travels forward seamed with the scars of many a conflict with opposing obstacles. All this while, although wasting, it is renewed by an unseen power—it evaporates, but is not consumed. On its surface it bears the spoils which, during the progress of existence it has made its own;—often weighty burdens devoid of beauty or value—at times precious masses, sparkling with gems or with ore. Having at length attained its greatest width and extension, commanding admiration by its beauty and power, waste predominates over supply, the vital springs begin to fail; it stoops into an attitude of decrepitude; it drops the burdens, one by one, which it had borne so proudly aloft; its dissolution is inevitable. But as it is resolved into its elements, it takes all at once a new, and livelier, and disembarrassed form;—from the wreck of its members it arises, "another, yet the same,"—a noble, full-bodied, arrowy stream, which leaps, rejoicing over the obstacles which before had staid its progress, and hastens through fertile valleys towards a freer existence, and a final union in the ocean with the boundless and the infinite.

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TOUR OF MONT BLANC, ETC.

CHAPTER I.

THE TOUR OF MONT BLANC—CHAMOUNI TO COURMAYEUR.

Glacier des Bossons—Its chief Phenomena—Route to the Montanvert—Glacier de Tacconay—Roches Moutonnees at Pont Pelissier—Baths of St. Gervais—Origin of the Blocks of the Val Montjoie—Nantbourant—Col du Bonhomme—Col de la Seigne—Allée Blanche—Courmayeur.

WHAT is called the *Tour* or circuit of Mont Blanc, is an easy journey round its base, beginning and ending at Chamouni. It is familiarly described in many works, and well deserves all the praise which can be bestowed upon the admirable and varied scenery through which it leads us. To those who look at matters more closely, it offers great interest, because it gives an opportunity of examining in succession every one of the valleys and ravines which take their origin in the chain of Mont Blanc, and which are usually in part or entirely filled with glaciers. I

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shall suppose the traveller starting from Chamouni so as to cross Mont Blanc at its western shoulder called the Col du Bonhomme, where he comes amongst valleys which pour their streams into the Isère, and thence to the Rhone; turning next to the eastward, and crossing the Col de la Seigne, he enters the Allée Blanche, a valley of singular grandeur on the southern side of Mont Blanc, and parallel to that of Chamouni. Here the river Doire (*Dora Baltea*) takes its origin, which, joining the Po below Ivrea, goes to swell the waters of the Adriatic. Courmayeur, a Piedmontese watering-place, is situated on the Doire, immediately behind the chain of Mont Blanc. The map, facing page 1, contains the route which we are now considering.

The first object of importance after leaving Chamouni is the Glacier des Bossons (the *patois* of Buissons, as it is spelt by De Saussure), of which the exquisite purity is known to all travellers, and which forms a beautifully conspicuous object in all extensive views of the valley. Its form is now for the first time laid down in the present (third) edition of the map in this volume of the Mer de Glace and adjoining mountains. Its source or main reservoir is the *Grand Plateau* immediately under the summit of Mont Blanc. It descends with great though not uniform rapidity towards the valley. I shall not stop to describe the phenomena of its *Aiguilles* of ice, and its greenish blue crevasses, so familiarly known.

This glacier has brought down beside and beneath it a great mass of debris of the rocks of Mont Blanc,

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(including serpentines of doubtful origin, but most likely from the foot of the Aiguille du Midi,) and these have formed a steep embankment, projecting into the valley, upon whose top the glacier rests. This gives to it a very remarkable appearance, especially as seen from Les Ouches, farther down the valley, where the fir woods conceal the origin of the glacier, and the lower part, thrust forward as it were from out of the side of the hill, stands forth like an island of crystal in the bottom of the valley. This part of the glacier is very nearly flat, and it is there easily crossed. Its breadth is here about 900 feet wide. The annual movement of the ice is about 650 feet at no great distance from the side, and no doubt more in the centre. Quite at its termination it falls over the slope of its moraine, and forms deep chasms and lofty pinnacles.

The Glacier of Bossons, like most of those in the same neighbourhood, attained, in 1820, its greatest extent in recent times, when the moraines advanced over cultivated fields, very near to the Hameau des Bossons. The traces of this progress are very visible. One enormous block has rolled out from amongst its neighbours on the eastern side of the glacier, and has mowed down a path for itself, through the wood, on that side, and there it lies on a slope surrounded by trees.

The Glacier of Bossons has no medial moraine. It descends (as De Saussure has remarked) in an unbroken continuity of ice from the very summit of Mont Blanc.

The structure is generally homogeneous, and almost

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snowy, or at least opaque white, with little green or blue tinge, except near its edges, where it is most icy. The *veins*, or bands, are distinct near the sides, and fall towards the centre in the usual manner.

The paucity of moraines, and the very slightly developed structure near the centre of the ice, occasion the extraordinary purity of the Glacier des Bossons, in which it has a remarkable analogy with that of Rosenlaui, in the canton of Berne, which has a somewhat similar course. The lower level of the glacier is unusually deep in the valley, not probably more than 3300 feet above the sea, or at least 5000 feet below perpetual snow.

The Glacier of Bossons is bounded on the east by a steep grassy hill, which rises to the foot of the Aiguille du Midi, where it is surmounted by the Glacier des Pélerins. A very interesting and by no means dangerous excursion may be made in this direction from the Glacier des Bossons to the Montanvert, or the reverse. Above the Chalet of Para (on the slope just mentioned, and the last habitation passed on the ascent of Mont Blanc,) is a grassy height which may be from 7000 to 8000 feet above the sea, and whence a most interesting view is obtained of the highest part of the Glacier des Bossons, the Grands Mulêts rocks, the Grand Plateau, and, indeed, the whole course of the route to the summit of Mont Blanc. From thence the Glacier des Pélerins is crossed (where De Saussure met with one of the narrowest escapes of his life,*) to the Sommité

* Voyages, § 675.

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des Croix, another green hill-top which offers a magnificent view; and continuing nearly on the same level avoiding or crossing with precaution the glaciers of Blaitière and Grépon, the ridge of the Charmoz is gained, along which the descent upon the Montanvert is easy.

The western side of the Glacier des Bossons is bounded by the Montagne de la Côte, a very narrow and steep ridge of rock, covered, however, by many pines, which separates the glacier just named from that of Tacconay, which descends immediately to the westward, and has a common origin with it amidst the snows of Mont Blanc. Naturally enough the earlier attempts to ascend Mont Blanc were made by the Montagne de la Côte, but it has been found on the whole easier to traverse the glacier. It was by the Montagne de la Côte that De Saussure ascended, and he slept on the summit the first night. The Glacier of Tacconay is remarkable from this circumstance, that it appears to have diminished notably in modern times, whilst that of Bossons has either increased or perhaps remained stationary. The modern glacier of Tacconay, fed almost entirely by avalanches of ice which descend a vast precipice near the Dome de Gouté, has but small moraines, whilst the ground below, and indeed the whole neighbouring valley in the direction of Les Ouches, is strewed with immense fragments of the granite of Mont Blanc, probably transported by this glacier when it formerly attained a greater bulk, and crossing the Arve, deposited these blocks on its farther bank, where the river takes a sudden turn to enter the valley of Servoz. Limestone occurs on both sides of

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the Arve, in the neighbourhood of Les Ouches, and is connected with the great secondary chain to the north of the Breven. Farther down, however, it is succeeded by a nondescript quartoze rock, forming the ridge between Servoz and St. Gervais. Between Les Ouches and Pont Pelissier, this rock is furrowed and polished in the most characteristic manner of the glacier action of the Alps, in a direction parallel to the length of the valley, and which it is impossible for one moment to doubt being due to the abrasion of some heavy superincumbent rubbing body. These forms may be compared to those produced in ductile plaster by the wooden mould with which the workman finishes a cornice. They extend to some height on the western slope where I first noticed them in descending from the Col du Forclaz. The whole of this part of the valley scarcely contains one angular fixed rock—all are smoothed and polished. Near Pont Pelissier, and on the western side of the Arve, are several hillocks presenting precisely the phenomena of *roches moutonnées*, and that their forms are due to glacier action, is rendered the more probable from the occurrence of blocks amongst them, one of which, of immense size and angular shape, seems poised on the very top of one of these bee-hive-like summits; such phenomena have been called by De Charpentier *blocs perchés*, and it is impossible to see a better example than the one I have just mentioned. It is truly surprising that in the minute mineralogical description which De Saussure gives of this route* he makes no

* Voyages, tom i. chap. 6.

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allusion to these phenomena. This is one example amongst many how obvious facts may escape the most experienced and assiduous observer, for De Saussure must have passed through this valley dozens, if not hundreds of times.

Some miles below Servoz, the valley of the Arve is joined by the Vallée de Montjoie on the left, transversed by the rapid and cheerful stream of the Bon Nant, which forms a remarkably pretty and well-known cascade immediately behind the Baths of St. Gervais. These baths are situated in a deep and picturesque ravine, a little below the village of the same name, whose gay and neat appearance at a distance, with its fantastic spire, decorated, like most of the churches of the province of Faucigny, with burnished tin plate, gives a sparkling character to the landscape. The mineral springs of St. Gervais issue from alluvium, through the floor of a subterranean gallery. The three hottest vary in temperature from 104° to 106° Fahrenheit. They contain iron and sulphur. Like most thermal springs, they issue near the union of different rocks. The valley on one side being composed of slate, quartz rock, and conglomerate, and on the other of limestone, limestone shale, and thick beds of gypsum, from which copious springs rise, with a temperature of 51°, at no great distance from the others. Several excursions of interest may be made from St. Gervais, which we will not stop to particularize; the views are very striking, although the higher Alps are concealed; but the limestone range of the Aiguille de Varens which

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rises above St. Martin, is singularly picturesque in its outline and detail. What interested me most, however, in my last visit to St. Gervais, was the discovery of what I cannot doubt to be numerous and extensive moraines in its neighbourhood, although the nearest modern glacier is some hours' walk distant.

It is to be observed, in the first place, that the valley is choked, as it were, in its lower part, by a mass of debris, through which the river has worked its way below the village of St. Gervais. The rock, where it appears, is usually slaty limestone; but the surface of the soil is every here and there strewed with blocks of granite, some of them insulated and of great size, at other times accumulated in ridge-like mounds along the face of the slopes, exactly like moraines. Amongst the woods on the western side of the valley, not far from the baths, I found blocks of from thirty to forty feet in length, composed of well characterized protogine or granite of the chain of Mont Blanc. An extensive and well marked moraine stretches along the face of the hill in the direction of Sallenches, and on the slope fronting the valley of the Arve, where it is almost inconceivable that a torrent could have been embayed, so as to deposit its blocks, supposing it could have moved such immense ones. They lie high above the open plain, and in a regular ridge, exactly like that figured on a previous page, from the *Mer de Glace* of Chamouni. The ridge just mentioned is partly grassy, and partly covered with small trees, but there is ample evidence of its composition being similar to that of a moraine.

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The most direct route from Chamouni to St. Gervais is not by Servoz, but across the Col de la Forclaz, which rises immediately above the village of St. Gervais. For a great height on this path, angular granite blocks are strewed about.

The Col de la Forclaz is a gorge, and therefore offers no view from the summit. The Col de Bellevue or Col de Voza, which crosses the chain of Mont Lacha, somewhat higher up, and communicates between the village of Les Ouches, in the valley of Chamouni, and that of Bionnay in the Val Montjoie, which commands the prospect of Chamouni and Mont Blanc, is, therefore, deservedly more frequented. It also gives an opportunity of inspecting the Glacier of Bionassay, which descends in a north-western direction from near the summit of Mont Blanc, and approaches near the Chalets of the same name. The Pavillon de Bellevue on the Col is nearly 7000 feet above the sea,* and yet erratic blocks are strewed all around. Not only is it inconceivable that a torrent should have passed over a hill like this, fit to carry great blocks of granite, but *the erratics of the Col mix insensibly with the modern moraine of the Glacier of Bionassay beneath, so that it is impossible to say where the erratic phenomenon ends, and where the glacial phenomenon begins.* This is an argument very striking on the spot, in favour of the glacial theory of erratics, and these very blocks of protogine may be traced, I believe, without any intermission, down to the Baths of St. Gervais, and perhaps to Sallenches. There are

* 6939 English feet. See Decandolle, *Hypsométrie.*

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three, if not four, distinct glaciers, which occupy the higher parts of valleys communicating with that of Montjoie: Bionassay, (already mentioned,) Miage, (to be distinguished from that of the same name in the Allée Blanche,) and Trelatête, which descends opposite to the Chalets of Nantbourant. All of these transport numerous primitive blocks, and sometimes deposit them upon insulated summits near the openings of the respective valleys. From Contamines (where there is an indifferent inn) to Nôtre Dame de la Gorge, (a chapel and mission-house, without a village,) the scenery is cheerful and pretty. There the defile narrows, and the steep rocks of gneiss on either hand, between which the stream struggles, are picturesquely clothed with larch and pines; and here, as is almost universal in valleys containing erratics, the surface of the rock is worn, rounded, and cut by long smooth furrows, which resemble those produced by glaciers. The torrent is passed by a bridge immediately above a fine waterfall, and we find ourselves in an upland pastoral country, but still pleasingly diversified by wood. A main branch of the Bon Nant descends a narrow rough gorge from the Glacier of Trelatête. We are now at Nantbourant, where travellers, making the tour of Mont Blanc, usually pass the night.

Nantbourant is about seven hours' walk from Chamouni. The Col du Bonhomme is between two and three hours farther. The way lies chiefly over upland pastures, not unmixed with good trees; but the higher part is bare rock, with patches of snow. The upper portion of the valley is composed of secondary limestone,

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containing Belemnites, and presents no granite blocks. But though the little plain of Les Barmes is covered with vast calcareous fragments fallen from the cliffs above, these do not extend (so far as I have observed) into the valley beneath; and the numerous primitive blocks already mentioned cease entirely above Nantbourant, that is, they commence with the Glacier of Trelatête; thus showing, that the transporting cause of these erratics had its origin, not in the natural prolongation of the valley (at the Col du Bonhomme) but in the highest tributary which contains a glacier.

The passage of the Bonhomme is one of the most dreary in the Alps; and in bad weather it is dreaded by the guides. The strong west wind spends itself upon this great outlier of the chain of Mont Blanc, and raises the snow into fearful eddies, called *tourmentes* in the French, and *guxen* in the German Alps, which are justly feared by those who have been exposed to them. Here two English travellers lost their lives some years since. Their last entry is still to be found in the traveller's book at Nantbourant. I have crossed the Col du Bonhomme three times,* and on one of these occasions, having merely a porter with me, who did not know the way, we got bewildered in fog amongst the rocks, from which we were only extricated by my referring to the map and compass, instead of following the directions of my companion. When the summit is gained, a wide view is seen over the valleys of the Tarentaise; and the traveller naturally thinks of descending immediately by

* And twice since this was written.

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a path right before him. Let him, however, beware of this, for it will lead him into the valley of Beaufort, which is most likely not his intended route. If going to Courmayeur, he follows an ill traced path on his left, over black shale, (or snow during part of the season,) which conducts him nearly on a level, after a quarter of an hour's walk, to a point somewhat higher than the last, which is called La Croix du Bonhomme, and which, on my last journey, I found to be 8195 feet above the sea. The view from thence is striking, although Mont Blanc is concealed. The mountains of the Upper Isère, stretching away towards the Mont Cenis, are fully in view; and conspicuous amongst these is the Aiguille de la Vanoise, a snow-clad pyramidal summit between Moutiers and Lans-le-Bourg, and which is undeniably one of the most elegant mountains in the Alps.

Immediately before the spectator is the very deep valley of Bonneval, which takes its rise at the foot of the Col de la Seigne, and which, turning sharply at the Chalets of Chapiu, (whose position may be seen at an immense depth below,) forms a very wild and uninhabited gorge, extending nearly to Bourg St. Maurice, in the valley of the Isère. By this route the traveller reaches the pass of the Little St. Bernard, which he may traverse to the Val d'Aoste. If, on the other hand, he wish to reach Courmayeur directly, he may either descend from the Croix du Bonhomme to Chapiu, and ascend to the Hameau du Glacier at the head of the valley, or he may cross the Col des Fours, which conducts him by a shorter, but rougher road; or, finally, he may scramble

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along the rocks by an intermediate path, without descending so low as Chapiu. The passage of the Col des Fours is still more savage than that of the Bonhomme, and 850 feet higher. I shall long remember an hour spent here in magnetic and barometric observations, in August 1832, amongst perpetual snow, and exposed to a biting wind. The middle path just alluded to is, in some respects, interesting. Instead of descending the steep pastures of Chapiu, we follow an obscure track amongst the rocks towards the east; and after traversing for some distance the limestone strata rising towards the north, of which the main chain is here formed, we come to a mass of granite, rising from the valley, *and overlying them* at a considerable angle. Near the same point, there is a magnificent view of Mont Blanc and the adjacent mountains, seen above the Col de la Seigne, which appears just in front. It presents the whole range, from the Grande Jorasse on the east, to the summit called Aiguille du Glacier on the west, from which the vast glacier descends which occupies the head of the valley of Bonneval.

At the Chalets of Motet, or Glacier, the traveller will probably make as short a stay as possible,* and will then proceed to ascend the Col de la Seigne, which (as has been said) separates the tributary streams of the

* That is, supposing the traveller to make the journey from Nantbourant to Courmayeur in one day. There is some advantage however, in reaching Motet the first night from Chamouni, and the accommodation, though not good, is bearable.

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Rhone from those of the Po. The ascent is very easy, but tedious. The summit is 8422 feet above the sea, by my observations, and was fortified (as I was informed) when the French army endeavoured to force this pass. From the top, the extent of the Allée Blanche is well seen, with the great masses of the chain of Mont Blanc, which bound it on the left. Mont Blanc itself presents a singular appearance in this direction, and would not be easily recognised by those who know it only in a northern or eastern direction. The western and southern faces are very steep, although not so absolutely precipitous as they would appear to be, when viewed in front. The former falls abruptly towards the Glacier de Miage; the latter, in the direction of the Cramont, or into the Allée Blanche itself. The bottom of the valley is here not more than 4000 English feet above the sea; consequently, this colossal mountain rises above it at a very short horizontal distance, and no less than 11,700 feet of vertical height, which, though not an unbroken precipice, is composed entirely of steep and savage rock, upon which the snow cannot lie for any extent. Its aspect is, therefore, far more imminent and imposing than on the side of Chamouni, where the eye is greatly deceived as to the actual *distance* of the top, and consequently as to its height. But here the details rather aid the perspective, and when seen in profile from the Col de la Seigne, the stupendous buttresses, by which the mountain is supported, and especially one prodigious Aiguille of granite,

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called Mont Péteret, come out in relief, although, when a front view is taken from Courmayeur, or its neighbourhood, these pinnacles, thousands of feet in height, are lost against the towering mass behind, which then seems to rise like a wall. I am unable to state the exact line of junction of the limestone with the central mass of granite. I apprehend, however, that it runs from some way to the north of the Col de la Seigne (which is calcareous) to the Cime des Fours, and so down nearly to Nantbourant, leaving the Aiguille du Glacier, and the greater part of the Glacier de Trelatête, within the primitive boundary. To the east the limit is, in a good measure, determined by the direction of the Allée Blanche, which separates, for some distance, the granite from the limestone. Two conspicuous summits, however, which appear near the foreground of the view, a little higher than the Col de la Seigne, are the Pyramides Calcaires de l'Allée Blanche of De Saussure. They are upon the left hand in descending. It is a walk of nearly five hours from the top of the Col to Courmayeur, during which we traverse the whole length of the Allée Blanche.* It is there met by another parallel valley, which opens exactly opposite to it, and forms, as it were, the prolongation of the Allée Blanche, for about five hours farther. This is called the Val Ferret, and terminates at the Col Ferret.

The chief glaciers of the Allée Blanche (on the north side) are the following :—1. The Glacier de l'Estellette;

* De Saussure states that below the Glacier de Miage the name of Allée Blanche is exchanged for that of Val de Veni.

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2. The Glacier de l'Allée Blanche; 3. The Glacier de Miage; 4. The Glacier de la Brenva. The second and third of these have formed barriers across the valley, by moraines, so as to have occasioned lakes from the interruption of the course of the river. That formed by the Glacier de l'Allée Blanche is nearly filled up by alluvial matter; but an extensive flat attests its former existence, together with the extensive barricade of debris, through which the river now tumbles in a foaming rapid. The moraine of the Glacier de Miage is, perhaps, the most extraordinary in the whole Alps, and has given rise to the Lac de Combal, which will be especially described in the next chapter. Below the Moraine of Miage, which occupies the valley for a great space, are some chalets, and then a level, fertile plain, whilst the valley widens, and becomes more romantic and less savage. Trees appear on both sides, especially on the right, where the forest is very fine, and clothes all the northern slope of a remarkable hill, with a conical summit, called the Mont Chetif, or Pain de Sucre, which is composed of granite, although separated from the great chain by secondary rocks. The paths through these woods are amongst the most beautiful and striking with which I am acquainted. That leading to Courmayeur, after attaining some height above the torrent, proceeds nearly on a level, until, emerging from the trees, we come into full view of the majestic Glacier de la Brenva which, formed in a hollow to the east of Mont Blanc, pours its mass into the valley which it has, in a good measure, filled up with its moraine,

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forming a kind of bridge, which it has pushed before it, and on which it bestrides obliquely the Allée Blanche, abutting against its opposite side, at the foot of the Mont Chetif. Its appearance and phenomena will also be described in the next chapter. A chapel, dedicated to Nôtre Dame de la Guérison, stands on the right-hand side of the way, exactly opposite to the ice; and another steep descent conducts us again to the bank of the river, which here turns abruptly, after its confluence with the stream of the Val Ferret, into a ravine, cutting the range of the Pain de Sucre. The united streams are passed by a wooden bridge at the Baths of la Saxe, and twenty minutes more brings the traveller to the beautifully situated village of Courmayeur, after a laborious walk of eleven hours from Nantbourant.

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The Glacier de Miage and its Moraine.

a. Pyramides Calcaires. *b.* Glacier de l'Allée Blanche.
c. Glacier de Miage. *d.* Col de la Seigne.

CHAPTER II.

THE GLACIERS OF MIAGE AND LA BRENVA.

The Ascent of the Allée Blanche—Moraine of Miage—Its Height and Extent—Chamois—Tributary Glaciers—Scene of Desolation on a Moraine—La Brenva—Its Remarkable Structure—A Superimposed Glacier—Interesting Contact of the Ice with the Rock beneath—Increase of the Glacier of La Brenva in 1818—A Tradition.

"I am acquainted with only one other scene in the world which can pretend to rival, in natural magnificence, the Glacier de Miage; I mean Niagara."

BASIL HALL.

COURMAYEUR would be worth a visit, if it were only for the purpose of examining in detail the Glaciers of

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the Allée Blanche. But this excursion is rarely made. Travellers are usually content with what they see of them in descending from the Col de la Seigne, and there are but few guides who have ever traversed either of these glaciers. A short day is sufficient for visiting the Glacier of La Brenva, but it is a laborious day's work fully to examine the Glacier de Miage. I shall begin with the latter.

I had twice before passed the Lac de Combal, and the moraine of the glacier which I have described as pushed out into the valley which it occupies for *several miles in length*, nearly a mile in breadth, and several hundred feet in depth. I had no small curiosity to see the chasm in the mountains whence this mass of debris had been derived, and to examine the glacier which had been and still continues to be so powerful an agent of degradation and transport. Accordingly, on the 15th July 1842, I left Courmayeur at half past five A. M., on foot, and reached the lower extremity of the moraine at the Chalets of La Visaille in about two hours. The Doire there struggles through the narrow ravine left between the moraine and the foot of the calcareous hills on the south side. The path keeps the side of the moraine, and is every year more or less injured by the falls of rubbish. In this ravine on the south side is a deep hole in the gypsum rock which occurs there, in which my guide Antoine Proment assured me that chamois frequently pass the night, and their young are sometimes taken alive. This surprised me, and I was inclined to doubt it, but we actually

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saw traces of them on a patch of snow within a short distance. In three hours from Courmayeur I reached the Lac de Combal, where the Doire issues from it. A dam has been formed so as to secure its regulated discharge, and to prevent accidents. This lake, as has been already said, is formed entirely by the moraine of the glacier, which is here shot out from the side ravine, and occupies the entire breadth of the valley. The moraine consists of two parts, the old and the new. It is the old which bounds the lake; the new moraine rises to a greater height, and sweeps more gently round, until it becomes parallel to the length of the valley. The old moraines are still fortified by the low walls with slits for musquetry, probably erected by the Piedmontese troops in 1794. It is strange to see this application of the artificial-looking mounds which the glacier has raised, and which bear no slight resemblance to a series of gigantic outworks of an extensive fortification. It is the outermost of these ridges which is so occupied. The arrangement of the others is abundantly singular, forming a series of four semilunar curves, with their convexity up the valley. A small lake is formed behind these moraines, which is farther enclosed by other convex, though less perfect moraines beyond, of which the greater part are now grass-grown. I am satisfied (after repeated examinations) that they owe their origin to a lateral outbreak of the ice of the glacier at some remote period—the lie of the ground having directed the overflow of ice towards the Col de la Seigne.

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Having observed the barometer at the level of the lake, I proceeded to ascend the modern moraine, which is higher than would readily be believed from mere inspection, and when I had gained the top and commanded a view of the Glacier de Miage, I observed the barometer again, and found the vertical height of the moraine (besides what is below the level of the lake) to be 395 feet.* Here I found the veined structure of the ice distinct, parallel to the length of the glacier, but dipping inwards at an angle of 70°.

The Glacier de Miage, as I have said, is here pretty level; it is shot out as it were from a narrow valley which works its way back into the very entrails of the great chain, so that the head of the valley is considerably to the north-west of the summit of Mont Blanc, which here presents inaccessible escarpments. The valley is almost straight, and the sides tolerably parallel, without subdividing itself into considerable branches. The ice is shoved along this uniform canal, and receives a few tributaries from either side, which descend with great steepness. One, which I remarked on the right bank of the glacier, descends at an angle, which, so far as I could ascertain it without being on its surface, was inclined 50°, and which is the steepest *unbroken* surface of ice I have ever seen. It descended a narrow couloir from the Aiguilles Rouges (called Mont Suc by De Saussure,) from a great height. The narrowness of the valley makes it like an unfinished

* The height of the Lac de Combal is, by my observation. 2091 feet above Courmayeur, or 6302 feet above the sea.

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excavation intended to have cut the chain of Mont Blanc in two, and struck me with surprise, although I was somewhat prepared for it after viewing the prodigious mass of solid matter which the glacier has poured out into the valley. It may be cited as a most striking instance of excavation by the ceaseless action of seemingly trifling causes. The continual fall of fragments detached from the neighbouring summits, loads the glacier with debris, which it bears incessantly down from the head of the valley, and discharges into the Allée Blanche; and as we judge of the size of a quarry from viewing its rubbish heaps, so here we have the mould and the cast, the die and the relief, the matter transported and the spot of its excavation.

I traversed the glacier in several directions, with a view to examine its structure, and whilst standing on the moraine I saw a female chamois and her calf cross the glacier, within a very short distance, towards the Aiguilles Rouges. They were followed by eight full-grown chamois, which I could watch all at once. They were tame, and stopped frequently to look about them without apparent alarm, and took gently up the hill. They are almost never hunted here. Near this part of the glacier, and also on the face of the Aiguilles Rouges, at a very considerable height, a mine of lead and silver was worked for some years. It was a strangely wild position for the hope of gain to allure any speculators to establish themselves. After the ore had been excavated and brought down the face of the cliffs, it had to

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be carried on men's backs for several miles over the ice before even a mule track was reached.

Two principal medial moraines occupy the centre of the glacier, and, as usual, their magnitude becomes apparently greater the farther the glacier descends, owing to their exposure, by the melting of the ice. The materials of these moraines are rather remarkable, and have been minutely described by De Saussure, who is the only author I have met with who describes this glacier. He particularizes a beautiful granitello, composed of crystallized felspar and schorl; amianthus, of the fine short kind like delicate fur, mixed with quartz, and which occurs in all the cabinets of the minerals of Mont Blanc; several kinds of serpentine, and (what I have not seen,) carbonate of lime crystallized with quartz.*

The tributary glaciers of the Miage are, as already said, very steep, and sometimes pour their icy flood down unbroken, at other times they descend in *avalanches* upon the main glacier, and become gradually and completely amalgamated with it. This is in the higher part, where the descending masses are rather of compact snow than ice. In this sense it is perfectly true, as stated by De Saussure, that the glaciers are partly fed

* I may mention that carbonate of lime is found, though very rarely, in the granites in the very heart of the chain; as at Les Courtes, near the Jardin, on the Glacier du Taléfre. An enormous price was asked last summer at Chamouni for a large crystallized specimen of this kind. In 1846, I found portions of limestone on this moraine.

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by avalanches, a position which has been too flatly contradicted. After three hours' walk upon the ice, I reached a considerable height upon the north-western tributary of the glacier, which was in this part covered with snow, and, indeed, passed into the state of névé. I took the height of the barometer, and found the elevation above the sea, the highest which I attained upon this glacier, to be 8051 feet. I then crossed the head of the glacier, which was here wet with wide water-runs, and remarkably free from crevasses, and very carefully examined the structure of the tributary glaciers, which fall into the principal glacier from the precipices of Mont Blanc. These afforded valuable studies of the manner of development of glacier structure, a subject which at the time particularly engaged my attention, and which I have since abundantly confirmed in similar cases.

In general, the structure of the glacier, whilst it is bounded by the chain of Mont Blanc, is well developed, both near the medial moraines, and near the sides, in nearly vertical planes, parallel to the length of the glacier.

I was not satisfied with having traversed the upper and more level part of the glacier in its whole extent, but I resolved to follow the surface of the ice as far as possible, after it spreads itself abroad in the Allée Blanche, in order to examine its wonderful moraines, and if possible to trace its structure. From a distance, this appears not to be very difficult, for the surface is not steep, its mean inclination in its middle part being about $5\frac{1}{2}°$. Its immense extent, however, deceives the

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eye as to its inequalities, and I scarcely ever remember to have had a more laborious or rougher walk than the traverse of the lower part of the Glacier de Miage, which I followed down its centre to the spot where, as will be seen by the eye-sketch, it divides into two branches. This icy torrent, as spread out in the Allée Blanche, appeared to me to be three and a half miles long and one and a half wide; but I am aware of the uncertainty of these measures. After struggling for a long time amongst fissures and moraines, I at length mounted a heap of blocks higher than the rest, and surveyed at leisure the wonderful scene of desolation, which might compare with that of chaos, around me. The fissures were numerous and large, not regular, like those of the Mer de Glace, traversing the glacier laterally, but so uneven, and at such angles, as often to leave nothing like a plain surface to the ice, but a series of unformed ridges, like the heaving of a sluggish mass struggling with intestine commotion, and tossing about over its surface, as if in sport, the stupendous blocks of granite which half choke its crevasses, and to which the traveller is often glad to cling when the glacier itself yields him no farther passage. It is then that he surveys with astonishment the strange law of the ice-world, that stones always falling seem never to be absorbed—that, like the fable of Sisyphus reversed, the lumbering mass, ever falling, never arrives at the bottom, but seems urged by an unseen force still to ride on the highest pinnacles of the rugged surface. But let the pedestrian beware how he trusts to these huge masses, or considers them as stable. Yonder huge rock,

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which seems "fixed as Snowdon," and which interrupts his path along a narrow ridge of ice, having a gulf on either hand, is so nicely poised, "obsequious to the gentlest touch," that the fall of a pebble, or the pressure of a passing foot, will shove it into one or other abyss, and, the chances are, may carry him along with it. Let him beware, too, how he treads on that gravelly bank, which seems to offer a rough and sure footing, for underneath there is sure to be the most pellucid ice; and a light footstep there, which might not disturb a rocking stone, is pregnant with danger. All is on the eve of motion. Let him sit awhile, as I did, on the moraine of Miage, and watch the silent energy of the ice and the sun. No animal ever passes, but yet the stillness of death is not there; the ice is cracking and straining onwards—the gravel slides over the bed to which it was frozen during the night, but now lubricated by the effect of sunshine. The fine sand detached loosens the gravel which it supported, the gravel the little fragments, and the little fragments the great, till, after some preliminary noise, the thunder of clashing rocks is heard, which settle into the bottom of some crevasse, and all is again still. In walking over ordinary rugged ground or rocks, the presumption is, that the masses have become shaken into the position of stable equilibrium—that is, that if a block be moveable, it will tend to roll back to its former position. But, on the glacier, the conditions are exactly reversed, and the consequences are proportionably more serious.

The bifurcation of the glacier does not appear to be

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the result of any fixed obstacle in the valley itself, which interrupts its progress. It is occasioned solely by the prodigious accumulations of the medial moraines, which, having for ages discharged their contents in front of the glacier, at length accumulated a mound in the centre which parted the ice in two with less resistance than would have been required to shove the prodigious mass forward. Arrived at the point of separation, I looked from the edge of the glacier into a hollow or ravine several hundred feet deep, having very steep sides, composed entirely of the most massive blocks which the glacier has brought down, and which are piled in vast confusion. Down these I scrambled with some labour, and found at the bottom, not the natural soil of the valley, but apparently the surface of an older moraine, which had spread wider, though not to so great a height. A stream struggles from amongst the blocks, and waters a small valley containing some stunted larches and alders, almost surrounded by the two arms of the glacier, whose moraines nearly meet below, but the two streams do not again coalesce.* Into this wild enclosure a few sheep are annually driven. I then crossed the torrent, descending from the Glacier of Frène,† which falls from the chain of Mont Blanc, but little below the moraine of

* The lowest part of the modern moraine is 5483 feet above the sea, or 1819 feet below the Lac de Combal.

† A small glacier at a great height, having a heart-shaped form as it expands on a slope after struggling through a rocky gorge. Its form is remarkably that of a *viscid drop*, similar to that of Kaagen in Finmarken, which I have described in "Norway and its Glaciers," p. 77.

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Miage, and returned to Courmayeur by a pleasant path through the Chalets of Frène, on the same side of the valley.

The Glacier of La Brenva may rank amongst the most accessible in the Alps. It descends more prominently into the lower valleys than almost any with which I am acquainted, and may be very completely seen from a convenient mule-road which traverses the Allée Blanche at a distance of less than three miles from the village of Courmayeur. I have already mentioned the extreme beauty of the ride through the pine-woods which clothe the northern face of the Mont Chetif, from which the stupendous chain of Alps may be surveyed like a theatrical scene, and amongst the trees beneath, the dazzling white of the glacier presents itself, supported on the bridge of rubbish by means of which it crosses the valley.

Two circumstances are especially worthy of note in this magnificent glacier: its veined structure, and the remarkable changes of dimension which it has lately undergone. As I am not aware of any author who has traversed this glacier, or who has described either of these interesting facts, I will devote a short space to them.

The Glacier of La Brenva consists (as De Saussure so far very well described it) of two distinct parts; first, the rugged and fissured portion, which is quite inaccessible, and which descends a ravine having its origin very near the summit of Mont Blanc, exactly behind the Monts Maudits; and the inferior, or gently sloping

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portion, which traverses the valley, as already said, upon a mound or embankment formed by itself, and beneath which the river Doire at present makes its way. The middle of the craggy descent is interrupted by a great prominence of rock, over which the descending ice falls in avalanches, and is so completely pulverized, as to be reduced almost to a snowy condition, in which it lies on the surface of the consolidated glacier, and goes through the same changes as in the transformation from névé into ice in ordinary glaciers. It is, indeed, a little parasitic glacier, cradled in the ice of the old one.

The cause of the sudden twist in its direction which the glacier takes when it issues from between the rocks is probably this,—The glacier, when it descended from the mountain, gradually accumulated an enormous moraine exactly in front of it, so that a valley was formed between the rock and the moraine on either hand, down which the glacier might naturally pass. It took to the left in the direction of the valley beneath, and the old moraine formed one of its barriers. There is no doubt that in this and similar cases the vast moraine on which the glacier rides is hollow at its centre, and the debris on either hand form a sustaining wall.

I must refer, for further details regarding the structure of the ice, to my larger work, and the diagrams and views which accompany it.

When the ice of the glacier abuts against the foot of Mont Chetif, it is violently forced forward, as if it would make its way up the face of the hill. Here the contact of the ice and soil is very well seen; and my friend M. le

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Chanoine Carrel of Aoste, with whom I walked several times in this neighbourhood, and who took an interest in such questions, discovered a point of contact between the limestone and a protuberant mass of ice which admitted of easy removal, thus showing the immediate action of the ice and rock. Having taken a man furnished with a strong axe, we proceeded together to the spot. The soil near the ice appeared to have been but recently exposed by the summer's melting of the ice. It was chiefly composed of clayey debris from the blue limestone. At the point marked by M. Carrel a piece of fixed rock opposed the ice, and was still partly covered by a protuberance of the glacier, which we speedily but gently cut away with the hatchet. The ice removed, a layer of fine mud covered the rock, not composed, however, alone of the clayey limestone mud, but of sharp sand, derived from the granitic moraines of the glacier, and brought down with it from the opposite side of the valley. Upon examining the face of the ice removed from contact with the rock, we found it *set* all over with sharp angular fragments, from the size of grains of sand to that of a cherry, or larger, of the same species of rock, and which were so firmly fixed in the ice as to demonstrate the impossibility of such a surface being forcibly urged forward without sawing and tearing any comparatively soft body which might be below it. Accordingly, it was not difficult to discover in the limestone the very grooves and scratches which were in the act of being made at the time by the pressure of the ice and its contained fragments of stone. By washing the surface of

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the limestone we found it delicately smoothed, and at the same time furrowed in the direction in which the glacier was moving, that is, against the slope of the hill. We succeeded in detaching some fragments of the rock with hammers, having even the sharp sand adhering to it, which I afterwards secured with gum-water, in order to illustrate the exact condition of a rock subjected to glacier action. It would be impossible to catch nature more completely in the fact than in the observation just stated. I afterwards returned with a skilful mason, who, with much labour, succeeded in detaching several specimens of the striated and polished surface.* Not only was the limestone friable, but the cleavage, being perpendicular to the surface, rendered it impossible to obtain a slab of any extent.

On the path leading to Courmayeur—a few minutes' walk below where the glacier now ends—are some admirable specimens of ancient polished and striated surfaces of the same limestone, which it seems impossible to doubt were produced by the ice at a former period.

So far as we can judge from the view which De Saussure has given † of the Glacier of La Brenva, and which he states was drawn in 1767, we must infer that the glacier was then greatly less extensive than at present. It seems almost certain that at that time the Doire did not pass *under* the glacier at all, but in front of it. He likewise mentions the chapel to which I

* One of these specimens is deposited in the museum of the Royal Society of Edinburgh.

† Voyages, tom. ii., plate III.

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have referred as exactly opposite to the glacier, and which is indicated in the map under the name of Nôtre Dame de la Guérison. It is also called Chapelle de Berrier. De Saussure speaks of it as in ruins in his time, having been allowed to go to decay on account of the superstitions to which it gave rise.* It appears, however, to have been rebuilt, and was again reduced to ruins, under much more remarkable circumstances. It is difficult to believe that the glacier attained only twenty-four years ago so enormous a size as to have risen up to the level of the chapel, and to have worked with such tremendous force upon the promontory on which it stood, built upon the rock itself, not fifty yards from the present one, as actually to have heaved both rock and building to such a degree as to fill both with fissures, and to cause the latter to be removed by authority, as in a dangerous state.

The notoriety and recent occurrence of these facts, makes it now easy to establish them beyond a doubt; and I have thought it well to do so on account of their great interest. That a series of comparatively cold seasons should have produced so enormous an increase in the unmelted portion of a glacier, is a fact of the highest importance to any speculations as to the circumstances under which glaciers might be enormously more extended than at present. So far was there from being any *marked* change of climate at the period when this and many other glaciers were undergoing an enormous enlargement, that, for the five years preced-

* Voyages, § 855.

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ing 1818, when the glacier of La Brenva attained its greatest size, the mean temperature at Geneva was 7°. 61 Réaumur, whilst the mean of the last forty years has been 7°. 75,*—a difference of not *one-third* of a degree of Fahrenheit. This difference is so insignificant, that it is most likely that the increase of the glaciers at that time depended rather upon an increased fall of snow, than upon any change of temperature.

The height of the ice was such in 1818, that the glacier rose up against the opposing wall of rock, until it covered the path, as Captain Hall attests;† and I was assured by eye-witnesses, that the hermitage connected with the chapel was supplied with water from a conduit, which descended from the ice of the glacier, which then had a higher level.

I obtained from the Syndic of Courmayeur a certificate, in the following terms, of the fact being entered in the archives of the commune:—"Je sous-signé, Syndic de Courmayeur, déclare après la vérification sur les régistres des archives du présent lieu, que la chapelle de Berrier à coté du glacier de la Brenva à été écroulée en 1818, dans l'endroit où elle étoit batie anciennement, par l'accroissement du dit glacier, qui étoit monté au niveau de la dite chapelle; que la Nôtre Dame a été transportée dans l'Eglise de cette commune où elle y resta pendant deux ou trois ans environ, et que la dite chapelle fut rebatie dans l'endroit où elle est maintenant en 1821-22."

* Dove, Temperaturvertheilung auf der Erde, p. 26.

† Patchwork, vol. i. p. 108.

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I have examined various other documents put into my hands by the Curé of Courmayeur, including the builder's report upon the state of the chapel, which leave not the slightest doubt of the extent and cause of the damage.* Indeed, the force by which the strata of limestone, forming the promontory, have been dislocated and rent asunder, is abundantly evident by inspection.

On a subsequent visit in 1846, I found a surprising increase in the volume of the Glacier of La Brenva. The ice had risen in height so considerably as to approach the pathway below the chapel. The horizontal area has increased greatly, and it seemed to be approaching the moraines of 1818. The surface was vastly more subdivided by crevasses. The main cause of this change appears to have been the great fall of snow in the two winters 1843-44 and 1844-45, followed by cold wet summers.

Tradition relates that the glacier in former times did not occupy the bottom of the valley, which was then covered with meadows and fields. My guide imparted to me the following story, which I give as I received it :—

On St. Margaret's day, the 15th July, no one knows in what year, the inhabitants of the village of St. Jean de Pertus, which was then overhung by the Glacier of La Brenva, instead of keeping the *fête*, pursued their worldly occupations ;—the hay is dry, they said ; the

* He says, "Je l'ai trouvé écroulée par la force du glacier, d'où il resulte de toute nécessité de la rétablir, puisqu'il n'existe que les ruines."

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weather is fine; let us secure it. But the sacrilege was soon punished. Next day the glacier descended in a moment, and swallowed up the village with its inhabitants. My guide added, in proof of the existence of this buried hamlet, that a person now living at Courmayeur, having gone, when a child of seven years old, with many others, for devotion, to the Chapel of Berrier, overlooking the glacier, heard the chaunting of vespers from under the ice, and saw a procession come out and return; but the vision was only seen by the child, for when he called the attention of the others to it, they beheld and heard nothing.

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CHAPTER III.

ENVIRONS OF COURMAYEUR—GEOLOGY.

Mineral Springs of Courmayeur and St. Didier—Remarkable Relations of Limestone and Granite in the Val Ferret—Montagne de la Saxe—Croix de la Bernada and Mont Chetif—Symmetry of the Geology on either side of the Alps—Ascent of the Cramont—Observations on Solar Radiation.

COURMAYEUR, by twenty-four corresponding barometrical observations which I have made, is 876.5 metres, or 2776 English feet above Geneva, and therefore 4211 above the sea. It is the highest considerable village in the great valley of Aosta, which takes its origin in the Allée Blanche and Val Ferret, at the southern foot of Mont Blanc, and merges into the valley of the Po at Ivrea. It is frequented by the Piedmontese in considerable numbers every summer, both on account of the mineral springs in its neighbourhood, and for the sake of the exquisite freshness of its climate. A more complete contrast, than between the walks of Courmayeur and the streets of Turin, in the month of July, it is hardly possible to conceive.

All who have visited this place, under favourable circumstances, agree in considering its position one of the finest in the Alps. No less than six routes diverge

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from it,—the road to Aosta; that of the Little St. Bernard; the Allée Blanche; the Col du Géant; the Col Ferret; and the Col de Serène, leading to the Great St. Bernard. I have travelled over all of these but the last, and several of them more than once. Consequently my visits to Courmayeur have been frequent; but it was only in 1842 that I made any stay there. I devoted a fortnight to explore its most interesting neighbourhood. At present, I shall only describe a few of the most prominent points chiefly connected with its geology.

The occurrence of mineral waters first strikes us. This is a phenomenon peculiarly interesting in a geological point of view, for it very generally happens that the appearance of mineral springs, especially if warm, indicates a great disturbance of the strata, and very generally the appearance of what are called *intrusive* rocks, such as granite. I have shown, for example, that in the Pyrenees, a district unparalleled perhaps for the multitude of its thermal springs, that these occur almost invariably at or near the contact of granite with stratified rocks.* The springs near Courmayeur have been described by De Saussure, and I have little to add respecting them. The waters of La Victoire and La Marguerite rise from alluvium, and are saline and purgative. The waters of La Saxe rise in the defile by which the Doire issues from the base of Mont Blanc, exactly at the junction of the limestone strata with a remarkable mass of granite

* Philosophical Transactions, 1836.

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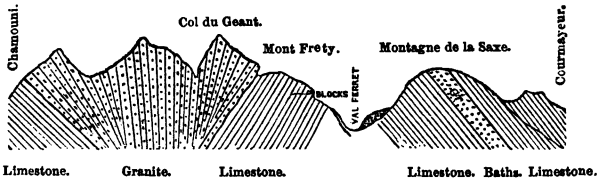
presently to be mentioned. They are sulphureous, and are used both for baths and internally; but the bathing establishment is rather mean. All the above springs are cold. Four miles below Courmayeur, at St. Didier, is another bathing house formerly much more frequented, and which is supplied by a hot spring which issues in the deep and picturesque ravine immediately adjoining, through which a torrent descends from the Little St. Bernard. The spring is conveyed partly through a subterraneous gallery. In 1839, when I visited the source, I found the temperature to be 95°.0 Fahrenheit, or 28° Réaumur; De Saussure found it to be 27°.5 Réaumur.

The relations of the limestone and granite in the neighbourhood of Courmayeur are very interesting and remarkable, and offer so striking an analogy to the phenomena of the same kind seen on the northern side of the Alps, that we cannot but regard them as important with respect to the formation of this chain. The



section is intended to illustrate these peculiarities. I had observed on my former visits to Courmayeur that there were appearances of limestone dipping under the granite of Mont Blanc, or rather of the Grande Jorasse

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on the north side of the Val Ferret. This I was enabled fully to establish, on my last visit, at several points. I obtained an excellent section by passing the moraine of the Glacier of La Brenva to the west of Entréves, and ascending the ravine, marked on the sketch, between that village and the glacier. There is there a complete superposition of gneiss to lias shale, forming a precise counterpart to that which occurs under the Aiguille du Bochard at Chamouni, and forming a portion of the fan-shaped stratification exhibited in the section, and which had been so far anticipated by De Saussure and M. Necker. In the ravine now mentioned, the junction may be traced for a long way towards the centre of the chain, the line of contact between the limestone and the overlying Protogine or Gneiss, being inclined in the higher part of the section 38° to the horizon, (dipping north-west,) and in the lower part of the section 50°. The strata are therefore bent at the junction, but at a little distance they have a pretty uniform north-west dip of 38°.

There is no difficulty in reaching the junction. The limestone shale is altered and crystalline near the contact. The gneiss is altered also. These phenomena bear the most striking analogy with those which I have seen in the Alps of Dauphiné, and which have been so well described by M. Elie de Beaumont. The junction may be traced nearly as far as the glacier of La Brenva, but not (I think) farther west. The Mont Frety, which lies immediately to the east of the ravine

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in question, is also of limestone, which dips under the granite of the Col du Géant, and a close examination would, I have no doubt, give proofs of the same thing all along the north side of Val Ferret as far as the col of that name, where the limestone becomes nearly vertical.

This analogy in the arrangement of the rocks on either side of the great chain is not the only one, for on either side of Mont Blanc is a secondary range also composed partly of granite. The Aiguilles Rouges (which however are not included in the section) are granitic, although separated from the main chain by the limestones of the valley of Chamouni, and the Mont Chetif, and part of the opposing Montagne de la Saxe near Courmayeur are in like manner granitic. The form of the latter mass, as shown in the section, is a great tabular body of imperfect granite, greenish, slaty, and containing an excess of quartz, with limestone above and below, very nearly in the manner in which the greenstone of Salisbury Crags, near Edinburgh, is interposed between the sandstones. Both the granite and limestone *rise towards Mont Blanc*, consequently, the limestones on the two sides of the Val Ferret rise towards the axis of that valley—a very remarkable arrangement. The tabular mass of Mont Chetif is cut through by the Doire at the baths of La Saxe, where there is an excellent section: the granite is then lost under the Montagne de la Saxe to the eastward, which is chiefly composed of limestone which envelopes the granite, and is also covered with herbage. I had

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however remarked a summit parallel to the axis of Mont Blanc, on the eastern part of the ridge of this hill, which I suspected to be granite, and having made an excursion on purpose, I found my conjecture to be confirmed. This summit is called La Croix de la Bernada; it may be easily reached either from the Val Ferret, or from the little valley of La Saxe. Farther east the granite is again lost under the limestone. The general dip of the limestone mountains farther from the main chain is towards the south-east.

In returning from the Croix de la Bernada by the Val Ferret, I observed a very remarkable accumulation of debris of granite which occupies the bottom of the valley to a great depth, and which has been evidently cut in two by the river, the deposit being of Alpine boulders resembling a moraine, which lie heaped upon the north side of the Montagne de la Saxe, as shown in the section already referred to. The existence of this moraine, if we may so call it, taken in connection with the deposit of similar blocks upon the face of the limestone outlier of the great chain called Mont Frety, and which will be more particularly mentioned in the next chapter, certainly appears to favour the conclusion that the glaciers, such as those of Entrèves and Mont Frety, which have now retreated towards the Alpine summits, once filled the entire space below, and transported these *debris*. They are deposited close to the sudden turn of the river between the Val Ferret and the baths of La Saxe.

I made another excursion towards the Mont Chetif to determine the relations of the granite in that

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quarter. I ascended the little valley above the village of Dolina, behind the Mont Chetif, until I reached a col or passage which leads into the Allée Blanche, and which commands a magnificent view of the range of Mont Blanc. This is called the Col de Checruit. I had here an opportunity of examining the granite of the ridge on which I stood, and of seeing it disappear to the westward under the limestone, which it has greatly altered just at the col. It is impossible to trace the connection of the granite of Mont Chetif with that of Mont Blanc, owing to the mass of debris and verdure with which the north slope is covered. I apprehend, however, that there is an undoubted connection between the granite of Mont Péteret and that of Mont Chetif, and that it crosses the valley in that place. The last exposed limestone is seen (as observed in the last chapter) on the south side of the valley just opposite to the Glacier of La Brenva.

From the Col de Checruit, I saw very distinctly the dip of the limestone of Mont Frety, under the granite of the Col du Géant, which I afterwards confirmed on the spot. The descent into the Allée Blanche, through some of the finest pine forests in the Alps, is a most interesting walk. Every one has noticed how rarely fine trees are to be seen in almost any part of the Alps. The forests on the north side of Mont Chetif are an exception, and whilst those in the valley of Courmayeur and La Thuille are very generally in a dying state, from some cause which seems not to be understood,—these are flourishing. Several encampments of char-

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coal burners are met with during the descent; and the latter part of the walk may be performed along a conduit of water through the wood, from which at intervals, the noblest views of the unequalled range of mountains and glaciers beyond, and in both directions, may be obtained. The path of the Allée Blanche being reached, I returned to Courmayeur by La Saxe.

De Saussure mentions the granite of La Saxe, though he does not advert to the peculiarity of its position, as respects the great chain. He notices, however, what he calls, "La superposition monstreuse des roches primitives sur les secondaires,"* at La Saxe. In the haste and exhaustion with which he descended from the Col du Géant,† he probably omitted to examine the rocks of Mont Frety. M. Sismonda, the able geologist of Turin, mentions‡ the superposition of granite to limestone at Pra Secco, beneath the Grande Jorasse, where I noticed it in 1841. But the remarkable symmetry of the chain on both sides has not, so far as I am aware, been hitherto remarked.

The ascent of the Cramont is one of the best known excursions near Courmayeur. The great object is to command the complete view of the southern precipices of Mont Blanc and the adjoining chain. Its elevation is considerable, being, according to my observations,

* Voyages, § 881. † Voyages, § 2034.

‡ Memoria sui Terreni stratificati delle Alpi, di Angelo Sismonda, p. 12.

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4932 feet above Courmayeur, and by contemporaneous observations at Aosta, I find it to be 9081 English feet (2768 metres) above the sea. The route usually followed is, to descend the valley of the Doire as far as Pré St. Didier, and to ascend the Cramont by its southern slope, although that mountain lies nearly due west of Courmayeur. It is, however, extremely precipitous on all sides, except the south. On the present occasion, I walked down to St. Didier in the evening, in company with M. Carrel, whom I have already mentioned, and having gone to bed for a few hours, we started by starlight, in a beautiful morning, at half-past three A.M., so as to gain the summit early. The first stage of the journey is on the mule-path of the Little St. Bernard, which rapidly ascends the ravine whence the hot spring issues, as already mentioned. On this road is one of the grandest bursts of scenery in the Alps—that, namely, which is enjoyed in descending from La Thuille, at the instant that the Aiguille du Géant, the Grande Jorasse, and the whole of the eastern chain of Mont Blanc, come first into view. The road is soon after left, and a long but easy path, through meadows, brings the traveller insensibly above the level of the adjoining hills. At length, the highest irrigation is passed, and a full hour's ascent remains over the short turf, by which the top of the Cramont may easily be reached in four hours from St. Didier. I was so fully imbued with De Saussure's enthusiastic picture of the grandeur of the station, that I was a little disappointed to find it not only equalled in height by some others in the neighbourhood, but over-

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topped by one, also of limestone, which stands between the Cramont and the Allée Blanche, effectually preventing the eye from diving into its depths, and thus measuring Mont Blanc at once from top to bottom, as is the case in the view from the Breven, above the valley of Chamouni. This interfering summit, which I cannot help thinking has been mistaken by some topographers for the Cramont described by De Saussure, lies nearly west from the Cramont, and at the head of the valley whose streamlet passes Dolina. It is, in fact, the prolongation of the Mont Chetif and Col de Checruit, and separates that valley from the Allée Blanche. The ascent is obviously easy and direct, much more so than that of the Cramont; the height is greater; it is nearer Mont Blanc, and commands completely the Allée Blanche and its glaciers. On all these accounts, I do not doubt that this hill is worth ascending, although it appears to be unknown to tourists, and even to natives, for I could not learn its name.

The Cramont is part of the limestone group, whose strata dip southwards, and the northern face being composed of the broken edges, is extremely abrupt. A ragged cliff extends for a long way, without any great variation of height.

M. Carrel, myself, and my guide Antoine Proment, had carried to the summit a considerable collection of meteorological instruments; for my intention was to spend the entire day upon the top, in order to observe the force of solar radiation. It is a familiar fact to mountaineers, that the sun's rays have an intensity and energy

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at great heights, which they entirely want on the plains. At first, this might be supposed imaginary, or to result from the reflection of the heat by the snow. On a station like the Cramont, where there is no permanent snow, this error is avoided; and no one who has compared the effect of a single day's exposure amongst the Alps, in discolouring the hands and face, with that of the hottest weather at Paris or Marseilles, will be disposed to question the former assertion. The difference admits of being shown instrumentally, by means of the valuable apparatus, called an actinometer, invented by Sir John Herschel, and I was provided with two of these instruments on the present occasion. My object was, in completion of some experiments made in former years, in other parts of the Alps, to ascertain the varying solar force at different hours of the day, at a height and at a season of the year in which the sun's rays travel through the atmosphere with least resistance.* I had, accordingly, brought these instruments on purpose from England, and I sought this hill in the month of July, soon after the solstice, for no other purpose. But such experiments are attended with numberless chances of disappointment. The day, though fine and bright, was by no means so cloudless as to warrant any conclusions from the experiments, which I continued every hour from 8 A.M. to 5 P.M., the whole of which time I spent upon the summit of the mountain. I had, therefore, abundance of time to survey the magnificent

* See a paper on this subject in the Philosophical Transactions for 1842, being the Bakerian Lecture for that year.

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panorama by which I was surrounded; and having brought up a very good telescope by Tulley, of 2¼ inches aperture, with a tripod stand, I could inspect minutely the forms and details, both of the nearer and more distant objects,—Mont Blanc, with its glaciers; the pass of the Col du Géant, exactly opposite to me, on which, with the glass, I could discover almost every step, and every difficulty of the road; and to the eastwards, the summits of Mont Cervin and Monte Rosa especially engaged my attention.

As it was now late, I proposed to Proment (M. Carrel had left us early) to descend to Courmayeur by the rocks. He had not before done it; but we found little difficulty in discovering a most direct and not dangerous passage of the cliff, which is here at least 1500 feet high. Observing the limit of the larch in the valley of Courmayeur to be remarkably well defined, I took the level of it, which I found to be 7200 feet above the sea. From this point, the walk to Courmayeur was easy and pleasant, and remarkably direct.

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CHAPTER IV.

THE PASSAGE OF THE COL DU GEANT.

Passes of the Chain of Mont Blanc—History of this Pass—Preliminary Obstacles—Departure from Courmayeur—Ascent of Mont Frety—Experiment on the Comparative Intensity of Moonlight, Twilight, and that of a Total Eclipse—Granite and Granite Blocks of Mont Frety—Arrival on the Col—The View History of De Saussure's Sojourn—And of his Observations—The Descent—Difficulties of the Glacier—Follow the Track of a Chamois—Reach the Mer De Glace—Montanvert.

> ——And followed where the flying chamois leaps
> Across the dark blue rifts, the unfathom'd glacier deeps.
>
> HEMANS.

THE chain of which Mont Blanc forms the culminating point has a very peculiar structure, and is connected in a remarkable manner with the great chain of Alps. One would hardly guess from the common maps, that Mont Blanc, and its adjacent tributaries, form a kind of oval group rather than a portion of a line of mountain continuous from the Mediterranean to the Tyrol, such as the Alps are usually represented. In length this group extends from the Col du Bonhomme, on the confines of the Tarentaise, to the Mont Catogne, in the valley of St. Branchier, above Martigny, a distance of thirty

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English miles in a north-east and south-west direction, whilst its breadth at right angles to the former, from Chamouni to Courmayeur, is only thirteen English miles. Now to perform these thirteen miles, a tedious journey of two days (one of them of nearly 12 hours' walking,) is necessary, because this chain or group being, generally speaking, impassable, must be gone round.

To avoid so great a circuit, the Col du Géant offers the shortest passage from the one valley to the other. It forms the crest of the chain, where the western branch of the Mer de Glace takes its rise; and, notwithstanding its immense height, it would probably be frequented but for the dangers of the glacier on its northern side. A tradition, common to this, and many other passes of the Alps, states, that formerly the glacier was less formidable, and that communication was not unfrequent between Chamouni and Courmayeur.* This has not occurred, however, within some centuries from the present time. The passage of the Col du Géant appears to have been reckoned impracticable as late as 1781. M. Bourrit, writing in that year, and speaking of the aspect of that branch of the Mer de Glace of Chamouni called the Glacier du Tacul, says, with respect to the crevasses:—"Elles sont si effroyables qu'elles font désespérer de retrouver jamais la route qui conduisait à la Val d'Aoste."† De Saussure, in the second volume of his travels, speaking of the Glacier du Tacul, does not say one word of this historical passage of the Alps,

* Bourrit, Voyages, I. 72. † Ib. I. 106.

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though he seems to have thought it just possible that the summit of Mont Blanc might be gained in this direction;* and, in the fourth volume, written some years later, when about to give an account of his memorable residence on the Col du Géant, he speaks of "la route nouvellement découverte"† from Chamouni to Courmayeur. This was in 1788.

There is said to be a passage which has been effected from the Glacier de Miage, which penetrates very deeply indeed on the south side of the chain of Mont Blanc, to the valley of Contamines, by the glacier also bearing the name of Miage, on the north side; but I have no accurate information of its accomplishment, and the appearance of the head of the glacier on the south side gives little encouragement to the attempt.

One other passage of the chain has, however, been made, and that is by the Glacier of Le Tour, near the Col de Balme, descending by the Glacier of Salena into the Val Ferret. This pass has since the earlier editions of this work been traversed and described by me.‡

Such are the only known passes of this wild country.

I was induced to undertake the passage of the Col du Géant, chiefly for two reasons; in the first place, from a desire which I had long entertained to visit a spot rendered memorable by De Saussure's extraordinary residence, and admirable observations; and, secondly, having occasion, on other grounds, to visit Courmayeur, and to return to Chamouni, I preferred any alternative to that of experiencing once more the

* § 629. † § 2025. ‡ Travels in Norway, &c.

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tedium of either of the circuits, by the Cols de Bonhomme and La Seigne, on the one hand, or the Cols de Ferret and Balme on the other. I had already traversed the former three times on foot in different years; and, though I had passed the latter only once, I wished to avoid a repetition of so long and dull a route.

Accordingly, having reached Courmayeur, in the beginning of July 1842, by the Col de Bonhomme, in order to go to Turin to see the total eclipse of the sun, my resolution was taken to return by the Col du Géant.

The guides of Courmayeur were, with one exception, unacquainted with the passage. I therefore wrote to Chamouni about the middle of July, desiring my old guide, Jean Marie Couttet, who knew the passage well, to come by the Col de Bonhomme, on the 19th, to be ready to return by the Géant on the 20th. I had previously ascertained that my guide of Courmayeur, Antoine Proment, would consent to undertake the passage with a single competent guide of Chamouni, for I had seen so much of the uselessness and inconvenience of numerous guides on such expeditions, that I resolved to take two only. Another item of expense and trouble was saved at the suggestion of Proment. Hitherto the passage had, in every instance, been effected in two days. In starting from Chamouni, the Tacul was the place of the first night's bivouac; and, in the one or two passages which have been made from the side of Courmayeur, the travellers had slept, or at least *lain* on the exposed and almost precipitous face on the southern ascent, which

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offers no spot at all adapted for the most indifferent night's quarters. Proment suggested passing the col without any halt, as the first part of the way, being without danger, might be performed in the dark. I determined, accordingly, to leave Courmayeur in the night, and to reach col soon after sunrise, or at least before the morning was far advanced.

Couttet arrived a day before his time, and the day of his arrival was also the last of fine weather, which had continued almost without interruption for a month. The south wind began to blow, the dew point rose, fogs covered the range of the Cramont, and formed a belt along the chain of Mont Blanc, and it was but too evident that the weather was deranged for some days. The provisions were ready, the guides astir, and I was called at midnight of the 19th, to consult upon the state of the weather; when it was unanimously agreed to be unfit for such an expedition. A repetition of the same occurrences took place for several successive days and nights. I was immoveably fixed in my purpose to return by no other route, and as resolute not to attempt the pass but with the finest weather. Proment, who was at home, bore the tantalizing delay philosophically enough, but Couttet fretted himself into such a state of impatience, that I believed he would have left me, and returned to Chamouni. Sometimes he urged me to depart, whatever might be the weather; but, when the hour of midnight came, and the council was called, his better sense warned him not to make so rash an attempt; then he tried to induce me to give up the

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plan, and return by the Bonhomme; — anything to avoid the ennui of Courmayeur. But I was inflexible. The 20th, 21st, and 22d July were spent thus. On the evening of the latter day, the weather gave a promise of mending, whilst the snow which had fallen on the col, and even a great deal lower, gave the prospect of some inconvenience from the cold, and increased difficulty in passing the glacier. Couttet put these prominently before me, as the last temptation to abandon my project; but, finding me resolute, he made up his mind for departure that night, good or bad.

I was called a little after midnight, between the 22d and 23d July, and to my inexpressible satisfaction, I beheld a magnificent calm night, illuminated by a moon just full. I had sent off by an opportunity some days before my heavier luggage, so that my pacquet was soon made. I carried, as usual, my barometer, hammer, compass, and telescope; one guide took my little knapsack, and the other a similar one containing provisions. I took some soup before departing; and we were detained, and my temper a little ruffled, by the stale imposition of a supplementary bill, containing items left out by inadvertence in the regular account paid the night before, which was presented to me at one o'clock in the morning, when remonstrance and appeal were alike unavailing. Travellers who undertake expeditions beyond the common run of excursions, cannot be too much put upon their guard against the systematic extortion of innkeepers, seconded by the love of indulgence of their guides. The better way

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would be to let the guides pay for themselves in every case.

Being fairly on foot at 30 minutes past 1 A. M. of the 23d July, my ill-humour was soon dissipated by the exquisite beauty of the scene which the valley of Courmayeur presented. The full moon was riding at its highest noon in a cloudless sky—the air calm and slightly fresh, blowing very gently down the valley. The village and neighbourhood lay, of course, in all the stillness of the dead of night; and as I headed our little caravan, and walked musingly up the familiar road which led to the Allée Blanche and the foot of Mont Blanc,—that vast wall of mountain, crowned with its eternal glaciers, seemed to raise itself aloft, and to close in the narrow and half shaded valley of Courmayeur, verdant with all the luxuriance of summer, and smelling freshly after the lately fallen rain. Of all the views in the Alps, few, if any, can, to my mind, be compared with the majesty of this, and seen at such a moment, and with the pleasing excitement of thinking, that within a few hours I hoped to be standing on the very icy battlements which now rose so proudly and so inaccessibly, it may be believed that I had never before regarded it with so much complacency.

Having left the baths of La Saxe on our right, we crossed the stream descending from the Val Ferret, and skirting the village of Entrèves under the guidance of Proment, who knew the bye-paths through the fields, we gained, after about an hour of pleasant walking, the woods of larch which clothe the south-eastern foot of

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the Mont Frety, as the pasture-mountain is called, above which the Col du Géant stands. The Mont Frety may be ascended either on its eastern or western side; both are steep and rugged, but not difficult. Some of the trees are of considerable size, and every now and then from between their trunks, I caught an admirable peep of the still scenery of the low country, bathed in moonlight, whilst, as we gradually but steadily ascended, our progress was measured by the successive hills or mountains which we left below our level: first, the Montagne de la Saxe—then the Pain de Sucre—finally, the Cramont itself sunk its head amongst more distant ranges of hills. Couttet had now taken the lead, and kept going steadily up hill at a very easy measured pace, but without the least intermission. In this way, admirable progress is made; the mind yields to the monotony of the exertion, and ceases to measure time, or to long for a remission of so moderate an effort. The footing being easy, no annoyance was felt from the want of full daylight, and the eye was left generally free to dwell on the objects around.

Two hours had passed from the time of starting before we emerged from the larch wood upon the bare slope of Mont Frety. Twilight was beginning to make evident progress in the serene sky above the Col Ferret. The moon was still high in the south-west, 20° or 25° above the horizon; and I was curious to notice the relative intensity of the moonlight and the dawn with reference to some experiments which I had made during the total eclipse of the sun a fortnight before. On that

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occasion, the light permitted me to distinguish small print with difficulty in the open air, and I think I could not have read writing. I compared it afterwards to the darkness in a clear evening one and a quarter to one and a half hours after sunset. The moonlight now was evidently incomparably brighter than the light of the eclipsed sun, and enabled me to read writing easily. As we ascended the slope with the increasing dawn on the right hand, and the setting moon on the left, I referred continually to a written paper in my hand, to mark the moment when it should appear equally legible by either. The difference of colour of the light caused some difficulty. It was the contrary of what we usually perceive: the moonlight seemed yellow and warm, the dawn was cold and grey. This was evidently no illusion, and arose from the quantity of blue rays reflected by the large surface of sky whence the twilight was derived. At 3 h. 30 m. A.M., I judged the two lights to be equal, and in a very few minutes the dawn had so manifestly gained upon the other, that it showed the method to be susceptible of some accuracy. Now, the summit of Mont Blanc was not touched by the sun until 4 h. 20 m. or 50 minutes later. This corresponds sufficiently well with my former estimate of the darkness of the total eclipse. It was very far less bright than the light of the full moon; as much less, in fact, as the dawn 80 or 90 minutes before sunrise (in the month of July) is than the dawn 50 minutes before sunrise, which is probably not much more than a fourth part.

This little experiment required no delay, and we kept

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always advancing. The Mont Frety projects considerably towards Courmayeur from the great chain, although, viewed from below, it seems an almost precipitous slope. There is a ravine on either hand, the highest portion of which contains a glacier—the Glacier du Mont Frety on the west, and the Glacier d'Entrèves on the right.* What may be called the summit of Mont Frety is a green pasturage, interspersed with enormous blocks. By frequent examination from below with a telescope, I had satisfied myself that the upper part was of granite, overlying strata of limestone, which dipped inwards at a considerable angle, and also that the blocks on the summit were granitic masses removed from some distance; both of these conjectures were confirmed by examination. The dimness of twilight permitted me only to ascertain generally the fact of the superposition of the granite to the limestone. As I approached the level of the scattered blocks of granite, I was struck by the peculiarity of their position. These enormous masses lie on an isolated ridge of very little extent, and on a steep declivity. There are ravines on either hand; precipices above, and the valley nearly 3000 feet below. The level at which they occur is very remarkably preserved; and without by any means vouching for the explanation, they seem to me not to have alighted on this promontory in the course of rolling down from the cliffs above, which is scarcely probable, but rather to have been deposited by the glaciers descending on either hand. If those glaciers formerly reached the valley beneath—

* These are the names given by De Saussure, § 2035.

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which is not unlikely—they probably occasioned the remarkable deposit of boulders exactly opposite to Mont Frety, on the farthest or south side of the torrent of Val Ferret, described in the last chapter. I have only to add, that the granite of the boulders on Mont Frety does not resemble the rock on which they lie, being more crystalline, and evidently derived from the neighbourhood of the Col du Géant. The blocks in the valley have the same character.

Having passed the sort of top or prominent flat of Mont Frety, and having now arrived at the foot of the final ascent after three hours of continuous walking without any pause, we halted by a spring to break our fast at 30 minutes past 4.

The sun was just about to rise, and this was the coldest period of the morning; at the height which we had now reached the frost was pretty intense, and the herbage white and crisp. I breakfasted heartily on hard eggs and cold tea, of which I had brought a good store in a gourd. After a halt of about 20 minutes, we proceeded, the cold continuing sharp—the thermometer was 30°.

The ascent now began in earnest, and, before long, we had left all grassy slopes behind, and clambered upon the bare rock. This was at first precipitous, though not dangerous. I had so completely studied the route with the telescope from the Cramont,* that I

* The vignette on the next page gives an imperfect representation of the ascent of the Col du Géant as seen from the Cramont. It is, however, somewhat deficient both in clearness and accuracy.

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should have had no difficulty in selecting, had it been necessary, the easiest path. There was but one point where it was necessary to touch the snow, and that

but for a few steps. Keeping always along the ridge, we climbed patiently amongst the loose masses of rock, which it required some care not to overthrow upon one another. We were yet nearly 1000 feet below the top, where Couttet felt his breathing a little affected, though not distressingly so. This is a symptom very common, and depending much upon the state of health at the time. I scarcely felt it even at the top; but in

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1841 I was distinctly incommoded at a lower level on the ascent of the Jungfrau. The guides say that it depends upon the state of the air; and David Couttet has assured me, that on some days, he and his brother have *simultaneously* felt inconvenience from the action of the lungs at very moderate elevations. Continuing steadily to mount, and invigorated rather than incommoded by the sun's rays, which now began to beat upon us, we reached the summit with scarcely any halt at 20 minutes past 7 A.M., or in 5 hours 50 minutes from Courmayeur. The vertical elevation is 7000 English feet, and it never before occurred to me to make a long ascent so nearly in one right line. The point at which we arrived, (marked *a* in the sketch) is the very lowest point of the chain, and is precisely at De Saussure's station.

The disagreeable feeling of cold had now entirely subsided. The sun's rays had taken off the frosty chill, though, in consequence of our increased height, the thermometer was only 29°, we established ourselves, nevertheless, not uncomfortably, in a hollow of the rock facing the south, where we could rest after this, the most toilsome though not the most difficult part of the day's work, and survey the astonishing prospect which was spread out before us.

We were at a height of 11,140 feet above the sea. It is very rare to be at this elevation at so early an hour as seven in the morning, and still rarer to combine this essential for a distant prospect with such magnificent weather as the day in question afforded.

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The atmosphere was, perhaps, as the event proved, too clear for very permanently fine weather,—not a cloud —not even a vapour was visible. The air of this lofty region was in the most tranquil state. Range over range of the Alps, to the east, south, and west, rose before us, with a perfect definition up to the extreme limit which the actual horizon permitted us to see. Never in my life have I seen a distant mountain view in the perfection that I did this, and yet I have often been upon the alert to gain the summits before the hazy veil of day had spread itself.

Perhaps it enhanced my admiration of the scene, that a great part of the labyrinth of mountains were familiar in their forms to my eye, and that from having penetrated many of their recesses in different journeys, this wide glance filled my mind with a pleasing confusion of the images of grandeur and beauty which had been laboriously gathered during many pedestrian tours, whose course and bounds I now overlooked at a glance. To the eastward, the Mont Cervin, with its obelisk form, never to be mistaken, presented evidently the same outline as I had sketched last year, from a point diametrically opposed, near Zermatt;—close to it, on the left, rose another peak, which I conjectured and afterwards ascertained to be the Dent d'Erin.* A little to the right, most exquisitely defined in outline,

* I cannot positively assert that the Mont Cervin is visible from the very col. I rather think not, but I saw it as described from a little lower level. I verified my recognition of the mountains, on the spot, by the excellent reduced map of the Sardinian Government triangulation, connecting France with Italy.

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yet with every detail delicately subdued by the undefinable blue of immense distance, was the whole mass of Monte Rosa, the rival of Mont Blanc, with its many heads of nearly equal height, whose geography I looked forward to exploring in the course of the summer. The hirsute and jagged rocks of the Valpelline and its neighbourhood formed the base out of which the

Monte Rosa from the Col du Géant.

chain of Monte Rosa seemed to rise; and a little more to the right lay the indentation of the Val d'Aoste, well marked by the complete separation which it forms between the mountains just mentioned and those which formed the middle group of the picture, the savage chain of Cogne to the south of Aoste. These mountains (which I had partly traversed in 1839) contain many summits of 11,000 and 12,000 feet high, scarcely known even by name, such as the Becca di None, 11,738 English feet above the sea, which has been repeatedly ascended by M. Carrel of Aoste, who even passed the night of the 7th July there, in order to witness the solar eclipse:—the Montagne de Cogne, the Grand Paradis, and the Aiguille de la Sassière, all streaming with glaciers. These were flanked on the left by the stern grey mountains of Champorcher, and on the right by the snowy wastes of the Ruitor.

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Behind the last rose the vast mass of Mont Iseran, which completely conceals the Alpine chain beyond, and of course the Monte Viso, which I had hoped to have recognised. Hitherward from the Ruitor the pass of the Little St. Bernard carries the eye to the valley of the Isère, whose whole course I had also followed up to its parent glaciers in the year 1839. Then a fresh range of snowy mountains to the right, above which rises conspicuous the Aiguille de la Vanoise, (between Moutiers and Lanslebourg,) a mountain which, for elegance, vies with any in the whole chain. To the west, and beyond, stood forth in clear perspective the yet more distant range of Mont Thabor, separating the valleys of the Arc and the Durance; and Savoy from France. There, a very well defined, though very distant group of familiar forms reached my eye. It

Profile of Mont Pelvoux.

was the Mont Pelvoux in Dauphiné, rising proudly from its rugged basis of lofty hills, the highest mountain between Mont Blanc and the Mediterranean, and of which I had laboriously made the circuit in 1841, in company with Mr. Heath, by passing cols which are themselves above 10,000 feet in height. The adjacent mass of Les Grandes Rousses, sloping towards Grenoble, closed this admirable panorama, which was thus cut short exactly where it would have become uninteresting, by

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the colossal mass of Mont Blanc, which, with its huge sentinel, the Mont Pétéret, (that vast rocky Aiguille which guards it on the side of the Allée Blanche,) stood forth in the closest proximity, and still at a height of 4600 feet above us.

I will not stop to describe the appearance of the valleys immediately beneath us, and of which the eye seized at once the ground plan from the great height at which we stood. It is very rare, as I have observed, to find so long and uniform a slope, affording a clear view to the very bottom, near 8000 feet deep. The Allée Blanche, with its glaciers, its lake, and its torrents, all *in plano*, the peaks of the Mont Chetif, and even the Cramont, now completely subdued, the monotonous length of the Val Ferret, the hamlets of Courmayeur and La Saxe almost at our feet, and the meadows of St. Didier, green as an emerald, and set in a solid chasing of precipices, begirt with pines,—all these familiar objects scarcely withdrew my attention from the magnificence of the wide Alpine view beyond.

The barometer (one of Bunten's) had been set up on our arrival, and whilst admiring the scenery, a second and more substantial breakfast of cold fowl was proceeding with marked advantage to the prospects of the journey,—for our appetites were excellent. I scarcely tasted the wine, and not at all of the brandy which Couttet had plentifully provided and liberally partook of. We had yet many hours' walk in the heat of the day, over dry snow, where no drop of water is ever seen.

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The barometer had been exposed for forty minutes in the shade, and was now carefully observed. It stands .08 millimetre lower than the corrected barometer at Geneva Observatory.

	Barom. m.m.	Att. Ther. Cent.	Det. Ther. Fahr.
Col du Géant, 1842. 23d July, 8 h. 0 m. A. M.,	507.9	+ 0.6	29.8°

The following had been the readings at Courmayeur (hotel de l'Ange, second floor) the previous day, during the whole of which the barometer had been steadily rising:—

Courmayeur, 22d July, 4	A.M.	657.5	18.0	
10	„	659.4	18.3	61
12	„	659.8	18.1	62
4	P.M.	660.25	18.0	65
8½	„	660.85	15.7	55
12½	„	661.35	17.5	50

The corresponding height of the barometer at Geneva was,

729.85 m.m. at 0° cent. D. T. 17° 2 cent.

whence the height of the Col du Géant above Geneva is 9803 feet,* above the sea 11,146 feet. Above Courmayeur, by the previous observations, 6979 feet. The Col du Géant, by observations at the Montanvert, on arriving there, is 4841 feet above that station. This result we shall afterwards find to agree with the direct comparison with Geneva, and hence we are disposed to place the Col du Géant at 11,146 feet above the level

* Calculated both by Baily's Tables and those of the French "*Annuaire*."

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of the sea. De Saussure determined it, trigonometrically, by reference to Chamouni, using the Aiguille du Midi as an intermediate point seen from both, and taking the barometrical height of Chamouni, he obtained for the Col du Géant 1747 toises, or 11,172 English feet. By his seventeen days' barometrical observations, compared with simultaneous ones at Chamouni, he obtained by the formula of Trembley, 16 toises less, reducing the height to 11,070 English feet. I have recalculated his simultaneous observations at the Col du Géant and Geneva, and have obtained so low a result as 11,028 feet.

The rock under which we breakfasted had supported the "Cabane" of De Saussure. I pleased myself with contemplating a board which yet remained of the materials of his habitation, and a very considerable quantity of straw, which lay under the stones which had formed its walls. The frosts of this elevation had preserved the straw in a pretty fresh state for half a century. There was also an empty bottle entire. This, indeed, had no claim to be so old, but it might be a relic of another illustrious guest,—M. Elie de Beaumont, the last traveller but one, who, seven years ago, had passed this wild spot.

De Saussure's habitation, as figured very intelligibly in the fourth volume of his work, consisted of a wretched stone hovel, six feet square, and two tents. Here this remarkable man passed sixteen days and nights, keeping, together with his son, M. Theodore de Saussure (the only surviving sharer of the expedition), almost perpe-

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tual watch upon the instruments which he had undertaken to observe. No system of connected physical observations, at a great height in the atmosphere, has ever been undertaken which can compare with that of De Saussure. At any time such self-denial and perseverance would be admirable, but if we look to the small acquaintance which philosophers of sixty years ago had with the dangers of the higher Alps, and the consequently exaggerated colouring which was given to them, it must be pronounced heroic.

De Saussure and his son arrived at the Col du Géant on the 3d July 1788, accompanied by a number of guides and porters, who carried two tents, and the utensils required for a long residence, having slept by the Lake of the Tacul. On the 19th of the same month he descended on the side of Courmayeur, having remained seventeen days at this great elevation. It may be believed that those guides who remained to share the wretched accommodations of this truly philosophical encampment, were not a little exhausted by the tedium of such prolonged hardships. De Saussure states, that he believes they secreted the provisions appropriated to the day of their descent, in order to render impossible a prolongation of their exile from the world. The astonishment of the country people on the side of Piedmont, whence the position of De Saussure's cabin is distinctly visible, it may be believed, was great; and it naturally showed itself in the form of superstition. It is still well remembered at Courmayeur, that that month of July, having been exceed-

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ingly dry, the report arose, that the sorcerers who had established themselves on the mountain had stopped the avenues of rain, and that it was gravely proposed to send a deputation, to dislodge them by force,—a task, probably, of some difficulty, for a few men could defend the Col du Géant against an army.

If we look to what was accomplished by these indefatigable observers, we shall find, that it was fully commensurate to the efforts made to attain it. Scarcely a point in the "Physique du Globe," which was not illustrated by their experiments. Geology, meteorology, and magnetism, were amongst the most conspicuous. I will pause a moment to state some of their leading results, which, as respect meteorology, are of permanent and, even now, almost of unique interest in the science. It were, indeed, to be desired, that the original registers, which are understood to be in the possession of the family, were published entire.

After mentioning the few observations which could be made on the plants and animals of this wild spot, and the rocks of which the col is composed, the Meteorological Observations are next discussed.* These were conducted every two hours, from 4 A.M. to midnight, by the alternate care of M. de Saussure and his son. We extract the following from the simple history of their days, each so like another, as to make the time seem to pass with extreme rapidity:—"Vers les 10 heures du soir le vent se calmoit; c'étoit l'heure où je laissais mon fils se coucher dans la cabane;

* Voyages, § 2049.

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j'allais alors dans la tente de la boussole me blottir dans ma fourrure, avec une pierre chaude sous mes pieds, prendre des notes de ce que j'avais fait dans la journée. Je sortais par intervalle pour observer mes instrumens et le ciel, qui presque toujours était alors de la plus grande pureté. Ces deux heures me paroissaient extrêmement douces: j'allois ensuite me coucher dans la cabane sur mon petit matelas étendu à terre à côté de celui de mon fils; et j'y trouvois un meilleur sommeil que dans mon lit de la plaine."*

The mean height of the barometer during 85 observations was 227.355 French lines. At Chamouni the corresponding mean height was 300.638 lines, and at Geneva 323.668 lines, the temperatures of the air being 3°.630, 17°.288, and 19°.934 Réaumur, respectively. The temperature of the mercury of the barometer is not given. De Saussure clearly established, — at a period, too, when the diurnal variations of the barometer were little attended to,—that these oscillations are *reversed in their direction at great heights*, the barometer standing highest at 2 o'clock in the day, and lowest in the morning and evening.

His thermometric observations are not less interesting or original. His deduction of the law of decrease of temperature in the atmosphere is, probably, the best that we yet possess, 1° Réaumur for 100 toises of ascent. He shows that a decreasing arithmetical progression satisfies the observations better than the harmonic law proposed by Euler; he points out the im-

* § 2032.

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portance of his conclusions to the theory of astronomical refractions; he insists on the diminishing range of daily and annual temperature as we ascend, and observes, that this causes a corresponding daily and annual change in the rate of decrement with height; and he shows that he had a clear idea of *space* possessing a definite temperature at a distance from any planetary body. He considers, with much neatness and simplicity, the variations in the progress and extremes of daily temperature in the month of July at the three stations of the Col du Géant, Chamouni, and Geneva. The mean daily ranges were

4°.257 Réaumur,
10.092,
11.035,

or in the proportion of 2 to 5 nearly at the first and last stations. The progress of the diurnal warmth is most rapid at the higher station, for whilst the lowest temperature of the night occurred at all the stations at 4 A.M., the mean temperature of the day was already attained at 6 A.M. at the col, at Chamouni at 8, at Geneva only at 9 A.M. These experiments are amongst the most definite and exact which we yet possess on these subjects.*

On solar radiation the experiments of De Saussure were not so conclusive as on most other subjects. He employed undefended thermometers, exposed in the sun

* See a paper on the Diminution of Temperature with Height in the Atmosphere, and on the Diurnal Curves.—Edinburgh Trans. xiv. 489.

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and shade, and generally not even blackened. Hence the difference of these was always trifling, and depended fully as much on the force of the wind, (as he himself acutely notices,) as upon any other circumstance. The effect of radiation from the surface of the snow, reducing its temperature below that of the surrounding air, he seems to have particularly noticed; and though he quotes Dr. Wilson's paper on the subject, (§ 2054,) it may be inferred, that he was not familiar with that curious observation at the time of his own experiment.

This remark, however, seems to have led him to make some most interesting observations on the temperature of the interior mass of snow. He notices that the hard crust of congealed snow on the Col du Géant extended to the depth of only some inches, and that below that, down to 12 feet, the temperature was continually 0° Réaumur, or the freezing point. The following passage, in which De Saussure reasons respecting the progress of the winter's cold into masses of snow and ice, compared to that in common soils, is so important to the modern theories of glaciers, and is, I think, so just, that I will quote it entire:—"La croute gelée," says he, "qui recouvre les neiges, est sans doute plus épaisse en hiver qu'en été; je ne crois cependant pas qu'elle ait plus de dix pieds d'épaisseur, et je suis persuadé, qu'au delà de cette profondeur les neiges demeurent tendres, et comme en été, au terme de la congélation. En effet si l'on adopte le principe que j'ai posé dans l'article précédente

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que la différence entre la température des plaines et celle des hautes montagnes n'est hiverque les deux tiers de ce qu'elle est en été, on verra que, puisque la température moyenne du Col du Géant, n'est en été que de 15 degrés plus froide que celle de Genève, elle ne le sera que de 10 en hiver. Ainsi comme nos plus grands froids n'excèdent guères 15 degrés au dessous de zero, ceux du col n'excèderoint guères 25, et ceux de la cime du Mont Blanc 30 ou 31 ; ce qui est un peu moins que les plus grands froids de St. Pétersbourg. Or, puisqu' à la baie de Hudson, dont le climat est beaucoup plus froid que celui de St. Pétersbourg, la terre ne gèle qu' à la profondeur de 16 pieds anglais, environ 15 pieds de France, on ne s'écartera pas beaucoup de la vérité en supposant que, sur les hautes cimes des Alpes, la neige ne gèle en hiver qu' à 10 pieds de profondeur ; surtout si l'on considère que la neige se laisse pénétrer par le froid plus difficilement que la terre."* These views will be found to be in accordance with those which have lately been brought forward to illustrate the Theory of Glaciers.

On the electricity of the atmosphere, De Saussure made many observations on the Col du Géant, of which it may be said, that the imperfections were those of every observation of the kind, and that even at the present day, it would be difficult to suggest very material improvements. He found the diurnal variations similar to those at the same season in the plains, showing that variation of temperature merely is not

* Voyages, § 2054.

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the cause of the dissimilar phenomena presented at different seasons.

A very interesting chapter refers to experiments on evaporation, and the dryness of the air, which, though tinged by the erroneous views on Hygrometry then prevalent, present several results of value. The rate of evaporation was determined by the ingenious device of exposing a moistened cloth on a stretching frame, whose loss of weight, in a given time, was determined by means of a nice balance. He thus ascertained, by direct experiment, "that, other things being the same, with respect to temperature and dryness, a diminution of about one-third in the density of the air doubles the amount of evaporation."*

Besides these, we have observations of great interest upon clouds, the formation of hail, an elaborate series of experiments upon the blue colour of the sky, with the cyanometer invented by himself, on falling stars, on the colour of shadows, on the transparency of the air, on the scintillation of stars, and on the duration of twilight. He observed a sensible twilight when the sun was 45° below the horizon, instead of 18°, as is usually reckoned in the plains. Pictet concluded† that this reflected light was derived from an elevation in the atmosphere of 121 leagues, where the air must be inconceivably rare, if indeed it exist at all. It seems so much more natural to suppose, as Arago has done, that the light of twilight has undergone several successive reflections, from comparatively dense air, that one wonders that so pro-

* § 2063. † De Saussure, Voyages, § 2090, *note.*

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bable an opinion was not earlier held. De Saussure likewise made use of the influence of light in facilitating certain chemical operations, as a measure of the intensity of light at the Col du Géant, compared to the level of Geneva.

Besides all these varied subjects of inquiry, we find that De Saussure devoted particular attention to the phenomena of magnetism on the Col du Géant. Indeed, it was one of his chief objects, as was shown by the extreme pains which he bestowed on the arrangement and observation of his magnetic apparatus. Seven times was the pedestal of his variation instrument constructed before it presented sufficient stability to afford consistent results, and it is not easy to appreciate the zeal which, in such trying circumstances, returned so often to the fulfilment of its object. He found the diurnal variations to subsist at this height as at Geneva and Chamouni, and to have generally the same direction. Their magnitude did not appear to be considerably altered. He was also probably the first person who attempted to inquire, whether the terrestrial magnetic intensity is sensibly diminished at these great heights. The observations made at Chamouni and the Col du Géant, at nearly the same temperature, agree very closely, and do not seem to warrant the supposition towards which De Saussure seems to lean (though with his usual caution), that the diminution was very apparent.*

* § 2103. See also a paper by the author, Edin. Transactions, vol. xiv. p. 22.

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In reviewing thus hastily the results of the memorable journey of De Saussure, we cannot but be struck with the completeness of a plan of observation in terrestrial physics, to which it would be difficult, even at the present day, to make any considerable addition, except as to *methods*. Himself on the borders of fifty, and with the assistance only of his son, at the age of eighteen, he filled actively the part of geologist, naturalist, and *physician*, during seventeen days and nights, at a height which, but a few years before, was believed to be inaccessible in Europe,* and where it might well have been doubted whether human life could continue to be supported. Whilst the ascent of Mont Blanc has ever been considered De Saussure's most popular claim to his deserved reputation, the annals of science will register the residence on the Col du Géant as the more striking, as well as more useful achievement.

I left the col to descend its northern side towards Chamouni at 8 A.M. A few steps brought me to the edge of the glacier, which may be considered as the head of the Mer de Glace in this direction. The view, though very grand, wants the effect of distance which the southern panorama presented. The summit of Mont Blanc is perfectly distinct; but it appears close at hand, and its elevation, though still 4600 feet above the spectator, loses somewhat of its grandeur from its apparent proximity. The chain of *Aiguilles*, which

* "Environ 180 toises plus haut que la cime du Buet, qui passait il y a quelques anneés pour la sommité accessible la plus élevée des Alpes."—*Voyages*, § 2032.

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separates this branch of the Mer de Glace (or Glacier du Géant or du Tacul) from the valley of Chamouni, completely bounds the view to the north, and yet does not rise to a great height above the eye. The row of their summits, exactly in the reversed order from that in which they are seen from Chamouni, is, however, abundantly striking, commencing with the Aiguille du Midi on the left, succeeded by the Aiguilles de Blaitière, Grepon, and Charmoz. The great tooth-like form of the Aiguille du Géant, belonging to the chain on which we stood, rose imposingly on the right, supported by a mass which completely cut off any view in the easterly direction. The comparatively small summits of the Aiguilles Marbrées, figured by Saussure, occupied the foreground in that direction. But perhaps the most striking part of the northern prospect was the dazzling mass of glacier upon whose surface we were now to walk for some hours, which occupied the basin to the depth of several thousand feet beneath us, intermixed with craggy pinnacles, which here and there connected themselves with the rocks on either hand, or stood out as islets amidst the breadth of unbroken white.

On rising from breakfast on the col, we had taken the precaution to tie ourselves together with two strong new cords which Couttet had provided; and as he took the lead, I being in the centre, and Proment behind, about ten feet apart, we had soon occasion to test their utility. The snow had fallen to a considerable depth during the late stormy days, and added considerably to

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the difficulty of detecting hidden chasms in the ice; almost the first step that Couttet took upon the glacier, he sunk up to his middle in a hole. By dint of reasonable precaution in sounding with a staff, even so trifling an accident was not repeated, and we passed safely over the beautiful snow beds, sloping at first gently towards the north. The map of the Mer de Glace gives a tolerably correct idea of the serrated ridges of granite peaks which break the monotony of the scene. The first which we passed on our left is called *La Tour Ronde*. This is connected with the main ridge of Alps, a little to the westward of the Cabin of De Saussure, where it terminates in a remarkably shaped hill, called Le Flambeau. It must be observed, however, that there are two rocks of this name, and which resemble one another extremely. The one marked on the map second Flambeau, is still farther west, and forms part of a transversal, and apparently inaccessible, ridge, which stretches quite across from the Glacier of La Brenva on the south to that of Bossons on the north, forming the mass of the Monts Maudits. These appear effectually to cut off access to the summit of Mont Blanc on this side, nor does De Saussure hint at the possibility of ascending it from hence. The western, or second Flambeau, is a summit conspicuous from several points, whence it could hardly be expected to be seen, as, for instance, from the Col de Balme.

The glacier here, enclosed between La Tour Ronde and the Aiguille du Géant, is very broad, but it is only one of the tributaries which aliment this branch of the

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Mer de Glace—another descends from between the first and second Flambeau by the foot of a promontory called Le Capucin, (see the map,) owing to the fantastical forms which the granitic obelisks here assume, and one of which has the rude outline of a human figure. Another and very large ice-flow descends from the Aiguille du Midi, and is more precipitous and broken; it breaks against a small rock called Petit Rognon, nearly opposite to the Aiguille Noire, and which is surrounded entirely by the glacier. Colonel Beaufoy first, and afterwards M. Romily of Geneva, ascended the Aiguille du Midi, at least up to the foot of the last rocky summit, which I believe is inaccessible.*

We continued to descend with precaution, though without any inconvenience, excepting from the sun, which was now high and brilliant, and its light reflected with more intensity than I had ever felt it from the *facettes* of the highly crystallised and fresh snow by which we were surrounded. I began to think that the passage was to be effected without any difficulty worth mentioning, until we arrived at the part of the valley where the three tributary glaciers already mentioned begin to unite, and are together squeezed through the comparatively narrow passage between the

* The details of this part of the chain on Mont Blanc in the map of the Mer de Glace, which accompanies this volume, are now published with considerable corrections obtained from a second expedition to the basin of the Glacier du Géant made in 1850.

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Aiguille Noire on the right, and the rock which I have marked *Petit Rognon* on the left. It is difficult to say whether the ascent or descent of such a glacier is more arduous; but in descending, one is least more taken by surprise; the eye wanders over the wilds of ice sloping forwards, and in which the most terrific chasms and rents are hidden like the ditch in a *ha-ha* fence. The crevasses of the glacier gradually widened; the uniting streams from different quarters met and justled, sometimes tossing high their icy waves, at others leaving yawning vacuities. The slope, at first gradual, and covered continually with snow, became steeper, and as we risked less from hidden rents, the multitude and length of the open ones caused us to make considerable circuits.

But the slope ended at last almost in a precipice. At the point where the glacier is narrowest it is also steepest, and the descending ice is torn piecemeal in its effort to extricate itself from the strait. Almost in a moment, we found ourselves amidst toppling crags and vertical precipices of ice, and divided from the Mer de Glace beneath by a chaos of fissures of seemingly impassable depth and width, and without order or number. Our embarrassment was still farther increased by the very small distance to which it was possible to command by the eye the details of the labyrinth through which we must pass. The most promising track might end in inextricable difficulties, and the most difficult might chance ultimately to be the only safe one.

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The spectacle gave us pause. We had made for the north-western side of the glacier, near the foot of the Petit Rognon, hoping to get down near the side of the rocks, although not upon them. But when we neared this part of the glacier, even Couttet shook his head, and proposed rather to attempt the old passage by the foot of the Aiguille Noire, where De Saussure left his ladder—a passage avoided by the guides on account of the steep icy slopes it presents, and the great danger which is run from the fragments of stone which, during the heat of the day, are discharged, and roll down from the rocks above. These stones are amongst the most dangerous accidents of glacier travels. A stone, even if seen beforehand, may fall in a direction from which the traveller, engaged amidst the perils of crevasses, or on the precarious footing of a narrow ledge of rock, cannot possibly withdraw in time to avoid it. And seldom do they come alone. Like an avalanche, they gain others during their descent. Urged with the velocity acquired in half rolling, half bounding down a precipitous slope of a thousand feet high, they strike fire by collision with their neighbours—are split perhaps into a thousand shivers, and detach by the blow a still greater mass; which, once discharged, thunders with an explosive roar upon the glacier beneath, accompanied by clouds of dust or smoke, produced in the collision. I have sometimes been exposed to these dry avalanches; they are amongst the most terrible of the ammunition with which the genius of these mountain

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solitudes repels the approach of curious man.* Their course is marked on the rocks, and they are most studiously avoided by every prudent guide.

It was, however, in the direction of La Noire that it was thought that we might pass; and we accordingly crossed the glacier to inspect the passage. But there, barriers still more insurmountable appeared. One prodigious chasm stretched *quite across the glacier;* and the width of this chasm was not less than 500 feet. It terminated opposite to the precipices of the Aiguille Noire in one vast *enfoncement* of ice bounded on the hither side by precipices not less terrible. A glance convinced every one that here, at least, there was not a chance of passing, unprovided as we were with long ropes or ladders. Nothing remained but to resume the track we had at first abandoned; for the whole centre of the glacier was completely cut off from the lower world by this stupendous cleft. Here the experience of Couttet stood us in good stead, and his presence of mind inspired me with perfect confidence, so that we soon set about ascertaining, by a method of trial and error, whether any passage could be forced amongst the labyrinth of smaller crevasses on the northern side of the glacier. A chamois, whose track we had followed earlier, seemed here to have been as much baffled as

* At saxum quoties ingenti ponderis ictu
Excutitur, qualis rupes quam vertice montis
Abscidit, impulsu ventorum adjuta, vetustas,
Frangit cuncta ruens: nec tantum corpora pressa
Exanimat; totos cum sanguine dissipat artus.
LUCAN, *Phar.* III. 465.

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ourselves, for he had made so many crossings back and forward upon the glacier, and had been so often forced to return upon his steps, that we lost the track for a time. This animal is exceedingly timorous upon a glacier covered with snow, since the form of the foot prevents it from offering almost any resistance when hidden rents are to be crossed. We had accordingly passed earlier in many places where the chamois had not ventured; but the case was now different on the hard ice. He took leaps upon which we dared not venture; and as we were never sure of not being obliged to retrace every step we made, we took good care never to make a descending leap which might cut off our retreat. Many a time we were obliged to return, and many a weary circuit was to be made in order to recommence again; but we seldom failed ultimately to recover the chamois track, which is the safest guide in such situations. The excitement was highly pleasing. The extrication from our dilemma was like playing a complicated game, and the difficulty of the steps was forgotten in the interest of observing whether any progress had been gained; for now we were obliged to descend into the bosom of the glacier, and to select its most jagged and pulverised parts, in order to cross the crevasses where they had become choked by the decay and subsidence of their walls. Thus hampered by our icy prison, we only emerged occasionally so as to catch a glimpse of what lay beyond, and to estimate our slow and devious progress. At length, by great skill on the part of Couttet, and patience on the part of all of us,

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(for we remained inseparably tied together all this time) by clambering down one side of a chasm, up another, and round a third, hewing our steps,* and holding on one by one with the rope, we gradually extricated ourselves from a chaos which at first sight appeared absolutely impenetrable, and that without any very dangerous positions.

Whilst we were in the middle of this confusion and difficulty, I could not help remarking how totally unserviceable any addition to the number of guides would have been. On saying as much to Couttet, he replied, "ils ne seraient bons que pour faire peur les uns aux autres," which was perfectly true. At length, having been for some hours engaged in these toils, we saw a comparatively clear field before us, the glacier became more level and compact, the crevasses were knit, and though no trace of life or habitation, nor the most stunted tree, was within any part of our horizon, the familiar localities of the Mer de Glace were apparent, the Tacul with the branching glacier, the Couvercle, the Jardin, the Charmoz, and the Moine. Here we halted about one o'clock, for we had now reached *water*, always a joyful sight to those who have been long wandering over snow fields. We drank of it freely, and the guides added fresh libations of brandy, which caused

* A geological hammer sharpened at one end is nearly as good an implement for this purpose as a hatchet. For this reason, amongst others, I generally wore it. A person so provided, if he falls uninjured into a crevasse, possesses the most essential means of extrication.

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them to complain of intolerable thirst and heat of the head all the rest of the way to the Montanvert, which, by confining myself to cold tea, and a very little wine with water, I entirely escaped.

The Aiguille Noire on the south, and the Aiguilles de Blaitière and Grepon on the north, here bound the Glacier of Tacul (or Géant.) The former gives rise to a pretty extensive lateral glacier, which descends from the foot of the Aiguille du Géant, and the Mont Mallet. I distinguish these two, as it will be seen is done on the map. But the Aiguille du Géant is itself sometimes called Mont Mallet, on the south side of the Alps. What I have termed Mont Mallet, on the authority of the guides of Chamouni, is a very remarkable peak, a little to the north-east of the Aiguille du Géant; and, so far as I can judge from a single altitude with the theodolite, somewhat higher, as indeed I had suspected, from observing both in different positions. The Géant appears to be 13,099 feet above the sea. Mont Mallet 13,068. The glacier descending from them is very convex and copious; and, by its union with the others, tends to consolidate the whole. It is from the Aiguille Noire, (probably so called from having formerly been visited in search of smoky quartz crystals), that the fourth moraine of the Mer de Glace, mentioned in a former chapter, descends. This moraine offers a feature similar to that of the Glaciers du Taléfre and de Léchaud, namely, that it is at first imperceptible, or nearly so, and increases in distinctness and mass as we descend the glacier. It is several miles below its origin, namely,

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near the "Moulins," that it is best developed. This very singular fact admits of no contest, but the mode of explanation varies. Some have supposed that it arises from the rejection of the stones through the matter of the ice, which presupposes that the fragments have been mixed up with or engaged in the solid ice. I believe that it arises from a very simple cause. Where two glaciers do not unite at exactly the same level, (the most common case), or even where, the level being the same, the one vastly preponderates, the lower or smaller glacier flows or forces itself some way under the upper or greater, and thus the fragments of rock borne by each to the point of union are naturally carried inwards at the sloping junction, where they lie for a time buried, until the thaw or waste of the surface brings them gradually to light. This is attempted to be represented on the map, and it is one of the most striking features of these accumulations.

The Glacier du Géant, below La Noire, is of great and nearly uniform width. I have, on the present and other occasions, traversed it in various directions. It is little fissured, and consequently great water-courses are formed, which pursue their way along the surface of the glacier, of which the inequalities are sometimes very considerable, so that the water at last finds an exit through some great funnel, or vertical opening in the ice; and here and there it stands in pools to a great depth.

Truncated glaciers of the second order festoon the wild enclosures of the valley on both sides.

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From the Aiguille Noire it seems but a step to the foot of the Tacul, but the elevation is considerable, the glacier very wide, and I was surprised at the distance which separated me from the regions with which I was then familiar. I must not omit to add, that the view in descending the Glacier du Géant is admirable. The picturesque mass of the Aiguilles du Moine and Dru, terminating in the enormous elevation of the Aiguille Verte, forms a group of singular majesty, which cannot be so well appreciated from any other point. The basin of the Glacier du Taléfre is likewise exposed, and the triangular rock of the Jardin stands forth in form and dimensions very apparent.

We all felt an exuberant cheerfulness at being relieved from our embarrassments, and ran cheerfully down the magnificent glacier, leaping crevasses which at another moment we would rather have avoided. Soon on the platform at the confluence with the Glacier de Léchaud, all was plain and direct; and I reached the Montanvert at a quarter before four P.M., without fatigue, headache, or lassitude. Here I remained, intending to spend some weeks. My guides, having finished their brandy, descended to Chamouni, where their arrival created, I was told, some astonishment, as no one had before crossed the Col du Géant in a single day, and as it was supposed that the fresh snow must at any rate have rendered the attempt impracticable. I slept that night somewhat sounder and longer than usual, but rose next morning with a freshness and elasticity to which the inhabitant of the plains is a stranger.

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A threatening of inflammation of the eyes confined me partly to the house, but it fortunately subsided: I felt at first a slight shortness of breathing on ascending a hill, but that also disappeared the second day. My guides, as I afterwards learned, entirely lost the skin off their faces. The barometer on my arrival was—

				m.m.	A.T.	D.T.
Montanvert, 1842. July 23.	3 h.	45 m.	P.M.	610.8	15.8 C.	51 F.
	5	15	„	610.2	11.4	51

This, compared with the observation of the Col du Géant, gives 4841 feet for its height above the Montanvert, or 11,144 above the sea.

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CHAPTER V.

FROM COURMAYEUR TO CHAMOUNI, BY THE COL FERRET AND COL DE BALME.

Piedmontese Val Ferret—Glacier of Triolet—View from the Col Swiss Val Ferret—Martigny to Chamouni—Glacier of Trient—Col de Balme—Glacier of Argentière.

In order to complete our narrative of the tour, or circuit of Mont Blanc, I proceed to describe shortly the route by the Col Ferret across the great chain of Alps, and that from Martigny to Chamouni by the Col de Balme, and those glaciers of the valley of Chamouni which have not as yet been enumerated. The former part of the route I performed in 1841, in company with Mr. Heath; I have three times visited the Col de Balme in different years.*

The passage of the Col Ferret is tedious, and perhaps less interesting than most others in the Alps; travellers usually, and perhaps wisely, prefer the longer round, by Aoste and the Great St. Bernard, which offers greater variety. This route, however, completes the closer inspection of the great chain of Mont Blanc, which

* And frequently since (1854).

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is very completely separated, both geographically and geologically, by the Col Ferret, from the mountains of which Mont Velan forms the culminating point. After having ascended the Piedmontese Val Ferret (the prolongation of the Allée Blanche), and descended the Swiss Val Ferret to Orsières; and having, either by Martigny or otherwise, reached the Col de Balme, and thus passed into the valley of Chamouni, the circuit of Mont Blanc and its chain is complete. Unless by passing difficult or dangerous glaciers, as in the case of the Col du Géant, this extensive chain may be considered as impracticable, or nearly so, in its whole length.

The ascent of the Val Ferret from Courmayeur seems monotonous after the more varied grandeur of the Allée Blanche and Val de Veni:—for here, though there are numerous glaciers on the left hand, they do not descend completely into the valley except near the head of it, and the mural precipices of the Jorasses, which separates this valley from the tributaries of the Mer de Glace of Chamouni, although magnificent at a distance, rise here so completely overhead as to conceal their own elevation, and the magnificent summits by which they are crowned. As the secondary mountains on the right hand—forming the prolongation of the Montagne de la Saxe, or Mont du Pré—offer nothing of interest beyond what has been already mentioned in a former chapter, I shall merely enumerate the glaciers which descend from the primary chain so far as I was able to ascertain their names from native guides. I am aware that the guides of Chamouni differ a little in

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their nomenclature. Eastwards from the glacier of La Brenva, we have first the Glacier of Mont Frety, and then that of Entrêves with the Mont Frety between. From the Aiguille du Géant descends the Glacier de Rochefort, and between it and the Grande Jorasse the Glacier de la Grande Jorasse.

The next in order is the Glacier de Triolet, which is nearly opposite to the head of the Glacier de Léchaud, and probably descends from a summit called by the Chamouni guides "Montagne des Eboulements." The event to which the name refers took place, I believe, in 1728, though I failed in obtaining at Courmayeur any *authentic* documentary evidence respecting it. According to a small printed work, which was shown to me, the avalanche, or sudden descent of the whole glacier, took place on the night of the 15-16th August in that year, and completely overwhelmed the châlets of Pré de Bar, which were situated exactly in front of it, destroying of course the inmates and cattle. The modern châlets of Pré de Bar are higher up on the southern side of the valley. They are very filthy.

Beyond the glacier just named is the Mont Ru, which separates it from the Glacier of Mondolent, the highest in the valley. This one appears to have greatly retreated of late years.

There are two passages of the Col Ferret, the Petit Ferret, which is a footpath, and the horse road, which is more circuitous. It is five hours' walk from Courmayeur to the col. The path of the Petit Ferret is close to the junction of the limestone and granite. The

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former is nearly vertical, rising against the latter at an angle of at least 70°. The junction is well marked, and the limestone is a tabular slate. Indeed, the chief interest of this route consists in the closeness with which the geological boundary is followed. Behind the Grande Jorasse, at a point called Pra Sec, two hours from Courmayeur, is a junction and apparent superposition of granite to limestone, which I noticed in 1841, and again from a distance in 1842. On neither occasion had I any doubt that the limestone actually dipped under the granite as, in the interval of the two observations, I had established that it does farther west. De Saussure, however, who ascended to the junction, maintains that the strata rise towards the granite (§ 871) although he seems to admit that farther west both the granite and limestone dip inwards; but he never asserts the superposition distinctly.

The view from the Col Ferret, looking back, is certainly one of the finest which I have seen. The prodigious outworks which sustain the mass of Mont Blanc on the southern side are more conspicuous here than from any other point, especially the Mont Péteret, which stands out like a majestic Gothic pinnacle. From hence, as from the Col de la Seigne, we see how far this side of the chain is from being an absolute precipice as it appears when viewed in front, as from the Cramont. The descent of the Swiss Val Ferret to Orsières offers no great interest, and it is of most tedious length. On the right hand is seen the passage of the Col de Fenêtres leading to the Great St. Ber-

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nard, by which the produce of the valley, and especially fire-wood, the property of the convent, is conveyed with the aid of mules.

Several glaciers are passed on the left; since, however, the side of the valley is exceedingly steep, several of these are only seen peeping over the precipices. One of them has evidently descended formerly into the valley, and has deposited in it an immense transversal moraine which now stands alone;—the glacier having retreated into the upland ravine.* It is commonly supposed to be from these glaciers that the vast granite masses descended which are still found on all the neighbouring slopes at a great height above the valleys, the Blocks of Monthey and those upon the Jura. The Aiguilles to the east of Mont Blanc are indeed the only ones in this district capable of yielding rocks of the kind in question, and the secondary mountains adjoining Orsières are strewed with masses, having evidently a common origin with those in the valley of the Rhone. These were well known to De Saussure,† and accurately described by his correspondent M. Murith, but they form one of the especial grounds of the theory of Venetz and De Charpentier, and have been more particularly described by the latter.

I shall not dwell upon the descent of the Dranse to Martigny, or the circumstances of the debacle of the Val de Bagnes, to which I shall shortly again recur; but I proceed to describe a journey which I took from

* Namely, the Glacier de Salena, which descends into the valley at Praz de Fort. See excursions in the Alps, appended to "Travels in Norway."

† Voyages, § 1022.

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Martigny to Chamouni, in September 1842, in which, avoiding as much as possible the common route, I visited the Glaciers of Trient and Argentière. The Glacier of Trient may be reached from Orsières by crossing the Mont Catogne, or from Martigny by the Col de la Forclaz. In the latter case, the village of Trient being passed, instead of turning to the right in ascending the valley, which would lead to the Col de Balme, I followed the eastern side of the glacier stream, and after a rough walk, (having missed the path,) I arrived at a group of châlets. The glacier is then well seen; it descends into a kind of basin, apparently inaccessible in its higher parts, from granitic pinnacles which divide this valley from the Val Ferret. Of these the most conspicuous is a fine point on the right hand, looking towards the head of the glacier; it was named to me Salena; and is no doubt also at the head of the glacier so called.

The lower end of the Glacier de Trient is about an hour's walk above the village of the same name. It is a well spread out glacier, with few ramifications, and a rather attenuated front; it somewhat resembles in contour the Glacier of the Rhone, or that of La Brenva, but it communicates more directly with the higher slopes. An inspection of the structure proved it to be quite normal; so much so, indeed, that I could have accurately predicted it beforehand, by seeing merely the external form of the ice. Suffice it to say, that it corresponds generally to the structure figured in the annexed woodcut, which, however, is altogether an ideal representation of a glacier. The crevasses in the

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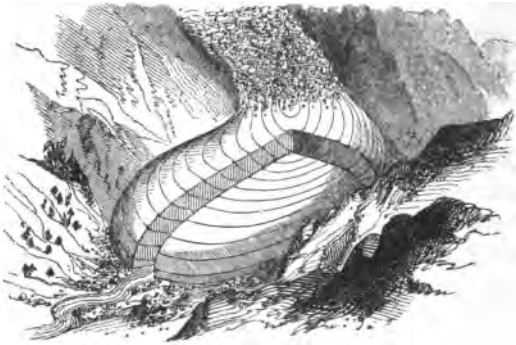
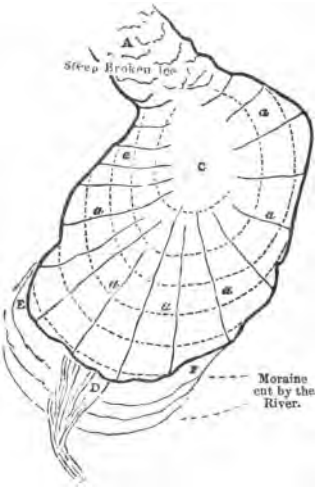
lower part are also *radial*, as in every glacier of this



Ideal sectional view of a glacier.



order, (see the full lines marked *a* on the lower figure,

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which represents the structure of the glacier of the Rhone). In its middle or mean portion, the glacier is, as usual, most readily traversed, and here very easily. I crossed over, making observations in different directions, and observing especially the character of the granite blocks which come down the western moraine from the summit of Salena just mentioned. These blocks are remarkably chafed and rounded, no doubt from the friction they have experienced between the ice and rocks; but neither in this or in any other case have I perceived an approach to *polish* on glacier-moved blocks, which cannot (I think) for a moment be confounded with those *smooth* pebbles and boulders plentifully found in the diluvium of all countries, and composing many of those gravel heaps which have been styled moraines. The nature of the granite, or protogine, appeared to me accurately to resemble that of the blocks of Monthey and those on the Jura. Supposing them to have been derived from the Pointe d'Ornex, they may either have descended the Glacier de Trient when it filled the valley of the Tête Noire, and joined that of the Rhone below Salvent, or, (as is more probable, from the distribution of the blocks,) followed the exterior of the chain by St. Branchier and Martigny.

The highest châlets on the eastern side, named Lali, are somewhat higher than where I crossed the glacier, and I reached the western bank under the châlets of Chazettes, which are close to a ravine which contains a stream from a glacier, which fills its higher part,

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and which descends from the ridge of the Aiguille du Tour. Finding nothing more particularly worth exploring, I proceeded to look for the path which, I had been informed, led directly to the Col de Balme, without descending to Trient. It was, I was told, above the precipices which bound the valley of Trient, to a great height on its western side. Although I met with no one here to give me information, I succeeded in discovering the path, which is a bold and romantic one, and crosses the mountain by which the Col de Balme is separated from the Glacier de Trient, at a great height on its precipitous eastern side. In the course of this walk, I obtained a more correct idea of the chain to which the Dent du Midi of Bex belongs, than I before had. Instead of being an insulated pyramid, or a pair of summits, as it appears from most points, it belongs to a jagged ridge, which is very elevated, and which extends from east to west, including great fields of snow, and glaciers of the second order. I arrived early at the little inn upon the Col de Balme, and slept there.

Next morning I left the Col de Balme at six, with fine weather, intending to explore the Glacier of Argentière. I had long had a great curiosity to visit this glacier, because, though so near Chamouni, it is very little known; and still more, because on all the models it is represented like an unbroken, perfectly uniform, nearly level canal, extending to the very axis of the Alps; and I was anxious, if possible, to determine its boundaries as respected the barriers of the Glacier du

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Talèfre, to which I understood it to be contiguous. It is a glacier little known to the guides of Chamouni; but a few of whom frequent it for the sake of the crystals, with which it is said to abound; but the length of the way is so great, and the snow lies so long and so deep upon the higher parts, which are sheltered from the sun by their northern exposure, that it is an expedition only to be attempted (I mean for the search of minerals) in the finest weather, and at a late season of the year, when the boundary of the snow is highest. But as the days are then short, it is necessary to sleep out, and this is no pleasant task in so very wild and remote a spot. So far as the report of the guides may be believed as to the locality of the minerals, (a matter on which the current information is little to be believed,) the Glacier d'Argentière is the richest field in the chain of Mont Blanc; and specimens of red Fluor Spar and smoky Quartz—the most expensive in the cabinets of Chamouni—are understood to have been brought from thence, often at imminent peril to those who secured them.

I have said that few of the professed guides have been on the higher part of the Glacier d'Argentière. The makers of the two best models of this part of the Alps have admitted to me, that they took their design of its locality from the perspective view on the Buet, which looks right up it. De Saussure, I believe, only mentions it once;* and as he speaks of having visited it and the Glacier des Bois in early spring, it is certain

* Voyages, § 740.

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that he can only have examined its lowest part. It is unnoticed, or all but unnoticed, by Ebel and by Pictet.

Understanding from the innkeeper on the Col de Balme—himself a good mountaineer—that the Glacier d'Argentière presented no unusual difficulties, I contented myself with taking along with me the man who at that time accompanied me (not Balmat), although he was also unacquainted with the way. As we knew that we must again ascend, we unwillingly went down the great depth which separates the Col de Balme from the foot of the Glacier of Le Tour. I then regretted that I had not taken the guide of the Col de Balme, who offered to conduct me by a little known route across the upper part of the Glacier of Le Tour, and to descend upon that of Argentière, near the Aiguille, which bears its name. But I was anxious to see the glacier in all its length, and not to come upon it in the middle. The glacier of Le Tour has considerably shrunk in its dimensions of late years, as well as that of Trient. Beyond the village of Le Tour, which I left on the right, a sharp ascent led me through extensive pastures, up to about the level whence we had started, and keeping along about that line we there came in sight of the Glacier of Argentière, at a great depth below us. I did not descend, however, but kept along the face of the hill, so as not to lose the height we had gained. The path became smaller—then a mere sheep track—and that again was subdivided. The mountain face became precipitous, and in some places went sheer down to the glacier. As my guide, or rather companion, was somewhat nervous on

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untried excursions—rather, perhaps, from a caution characteristic of the Savoyard peasant, of getting himself into trouble by bringing a traveller into danger, than from any want of personal courage—I took the lead both on this occasion and on the previous day, and fortunately extricated myself satisfactorily from the precipices, which, when seen in the afternoon from the opposite side of the glacier, were of a sufficiently dangerous kind, and had we attempted a passage either higher or lower, we must have failed. The precipices passed, a long and fatiguing slope of debris was to be crossed, and then a vast lateral moraine of the glacier, covering a great surface with huge blocks, which, however, afforded solid and comparatively easy footing, after what we had passed. Amongst these blocks I was astonished to observe some sheep, which must have been driven across the nearly pathless rocks which I had traversed.

Nearly opposite this moraine, the glacier is tolerably flat, and might be traversed from side to side; but being precipitous both above and below, I continued along the moraine until I came to the foot of the rocks descending immediately from the Aiguille d'Argentière to the glacier. There I made for the ice, having had a fatiguing walk of four hours from the Col de Balme, before setting foot upon the glacier.

The Aiguilles of Argentière and of Chardonnet separate the glaciers of Le Tour and Argentière, and between these Aiguilles there descends a steep tributary glacier to the level of the latter. On the ridge connected with the Aiguille de Chardonnet there is a

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remarkable instance of a glacier of the second order, which appears to be rapidly disappearing. Its former boundary is indicated by the whiteness of the rock where it has been beneath the ice, of which there is now scarcely a trace.

On the Glacier of Argentière there is only one medial moraine of any extent, which comes from the higher part of the glacier, on the left in ascending. There are two lateral glaciers also on the left, which appear to communicate with the Glacier of Le Tour. Having gained the ice, I proceeded without difficulty, for on the higher part it is not much crevassed, and the higher we ascend the more level it becomes. The Aiguille Verte rises in great majesty on the right, and from its rugged sides some short glaciers descend to meet that of Argentière. I walked on, having reached the névé, or perpetual snow, until I had left the Aiguille Verte quite behind me, and was now within a short distance of the head of the glacier, that is to say, not much exceeding an hour's walk. The surface is even, and the whole topography is easily seized. The direction of the glacier, which up to the Aiguille Verte had been S. 25° E., now became S. 50° E. This bend in the direction corresponds to the basin of the Glacier du Talèfre, which is only separated, as has been said, from the higher part of the Glacier d'Argentière by the range of the Tours des Courtes, which appears to be of small thickness, and is one continued precipice on its north-eastern side. I can only guess at the height of the upper part of the Glacier d'Argentière, as I was provided with an imper-

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fect instrument. It is, no doubt, more than 8000 feet above the sea. The extremity of the view is terminated by a snowy peak, which I believe is probably one also visible at the Jardin.

The structure of this glacier is very confused. The vertical linear bands are, of course, visible throughout up to the névé; but it would be difficult to trace the curves. The middle and lower part is excessively crevassed; and the extremity near Argentière has very much shrunk of late years.

After a careful examination of the higher part I returned by the western side, under the Aiguille Verte, and gained the bank somewhat below the tributary glacier on that side. There is a small snowy peak to the north of the Aiguille Verte, which is connected with it by a ridge dividing the ice which falls in the direction of the Mer de Glace and in that of Argentière. From the same peak descends a small glacier on the north side, called Glacier de la Pendant, or de l'Oignon, which, judging from the polished rocks below, appears to have been formerly more extensive. From the highest châlets there is a path to the village of Argentière, and another less easily found, which descends near Lavanchi. Both pass through fine fir wood. From thence the village or Prieuré of Chamouni is soon reached.

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Source of the Arveiron.

CHAPTER VI.

DESCRIPTION OF THE MER DE GLACE OF CHAMOUNI.

Physical Geography of the Ice-World—Glacier de Lechaud—Glacier du Géant—Source of the Arveiron—Hameau des Bois—Côte du Piget—Ancient Moraine of Lavanchi—Le Chapeau—Mauvais Pas—Cattle traversing the Glacier—Blue colour of Ice—Montanvert—Accommodations—The view—Les Ponts—L'Angle—Passage of the Glacier—Les Charmoz—Trélaporte.

> Nec vidisse sat est:—durum calcavimus æquor.
> OVID. *Trist.* III. x. 39.

THE Glaciers of Chamouni first became an object of interest to tourists when they were explored by Messrs. Wyndham and Pococke in 1741. And no station can be more convenient than the village of Chamouni for

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becoming acquainted with the main features of these real marvels of creation. Fashion or the animosities of nations may for a time divert the current of travel in this or that direction; but most infallibly the scenery of Mont Blanc will continue to attract the great influx of intelligent tourists of every land, so long as the sublimity of nature shall move the sensibilities of mankind.

The glacier which occupies the vast gorge or system of valleys to the east of Mont Blanc, is usually, and I believe, correctly termed the *Mer de Glace;* *—the name of *Glacier des Bois* being confined to its lower extremity, where, escaping from the rocky defile between the promontory of the Montanvert, and the base of the Aiguille du Dru, it pours in a cascade of icy fragments, assuming the most fantastic forms, into the valley beneath, between the fir woods of Lavanchi on the one hand, and those through which the usually frequented path to the Montanvert passes, on the other. If I do not always use the *Glacier des Bois* to signify the lower, and the *Mer de Glace* the middle and upper part of this vast ice stream, I shall not probably incur any risk of being misunderstood.

It is proposed, in this chapter, to describe such peculiarities of structure, either in the valley in which the glacier lies, or in the ice itself, as may tend to

* The term may probably be traced to the old and erroneous notion of a vast snow and icefield occupying a *longitudinal* valley in the heart of the chain, of which the Glacier des Bois, d'Argentière, du Tour, &c., were common outlets.

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illustrate the physical geography of the district; and especially the theory of existing glaciers, and of their former extension; and if the details into which I shall enter appear somewhat minute, it may be well to recollect, that the absence of such local knowledge has been the cause of much of the uncertainty under which we at present labour as to the past history of these wonderful masses. A permanent record of their present limits, condition, and phenomena, will be an important document for future times; and the conviction of this led me to incur the very great labour of constructing a detailed map, which accompanies this work, of nearly the whole glacier. The frequency of visits by ordinary travellers to the higher parts of the Mer de Glace, compared to what was the case when this work was first published, gives a popular interest to topographical details which they did not then possess. I take this opportunity of recommending an excursion on the glacier as far as "Le Tacul," to those tourists who might find the whole journey to the "Jardin" too fatiguing.

There is nothing more practically striking, or more captivating to the imagination, than the extreme slowness with which we learn to judge of distances, and to recognise localities on the glacier surface. Long after icy scenes have become perfectly familiar, we find that the eye is still uneducated in these respects, and that phenomena the most remarkable, when pointed out, have utterly escaped attention amidst the magnificence of the surrounding scenery, the invigoration which the bracing

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air produces, and the astonishing effect of interminable vastness with which icy plains outspread for miles, terminated by a perspective of almost shadowless snowy slopes, impress the mind. I cannot now recall, without some degree of shame, the almost blindfold way in which I was once in the habit of visiting the glaciers. During three different previous summers* I had visited the Mer de Glace, and during two of them, 1832 and 1839, I had traversed many miles of its surface; yet I failed to remark a thousand peculiarities of the most obvious kind, or to speculate upon their cause, or else the clearer apprehension which I now have of these things has wholly driven from my mind the previous faint impression. Of the existence of the moraines, generally, and their cause, as well as of the fact of the descent of the glaciers, I was aware, but I can scarcely recall another of the many singularities which they present, as affecting my imagination then in a lively manner—the wear and polish of the rocks—the vast masses of travelled stone thrown up high and dry far above the present level of the ice, like fragments of wreck, indicating, by their elevation on the beach, the fury of the past storm—the pillars of ice, with their rocky capitals, studded over the plain like fantastic monuments of the Druid age—or the beautiful veined structure of the interior of the ice, apparent in almost every crevasse,—these things, so far as I now recollect, were passed by unobserved.

Even in the summer of 1842, during which the pre-

* The journeys described in this volume were made in 1842.

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sent survey was made, I had abundant proof of how much remained unseen only for want of the faculty of concentrating the attention at once upon all the parts of so wide and glorious a field. We are not aware, in our ordinary researches in Physical Geography, or the natural sciences in general, how much we fall back upon our *general* knowledge and *habitual* observation in pursuing any special line of enquiry, or what would be our difficulty in entering *as men* upon the study of a world which we had not familiarly known as children. The terms of science are generally but translations into precise language of the vague observations of the uncultivated senses. Now the ice-world is like a new planet, full of conditions, appearances, and associations alien to our common experience; and it is not wonderful that it should be only after a long training, after much fatigue, and dazzling of eyes, and weary steps, and many a hard bed, that the Alpine traveller acquires some of that nice perception of cause and effect—the instinct of the children of nature—which guides the Indian on his trail, and teaches him, with unerring philosophy, to read the signs of change in earth or air.

But to return to the Mer de Glace. A glance at the map will show that this great ice river has near its origin two divided streams, derived from different sources. The westward branch, denominated the Glacier du Géant, or Glacier du Tacul, has its rise in a vast basin immediately to the eastward of Mont Blanc, which has been described in the account of the descent from the Col du Géant. The other branch, called

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the Glacier de Lechaud, has its origin at the foot of La Grande Jorasse, one of the highest mountains of the chain which separates the Val Ferret from that of Chamouni. This glacier is smaller than its neighbour, although it is swelled before its junction by the tributary ice of the Glacier du Talèfre, which falls in upon its right bank from a detached basin, encircled by inaccessible pinnacles of rock, in whose centre is the spot called the Jardin, now so frequently visited. The length of the whole Mer de Glace is estimated by the guides of Chamouni at eighteen leagues, an enormous exaggeration, if leagues of the usual horizontal measure be reckoned. A league, however, is generally understood to mean an hour's walk amongst the mountains, and in that view the estimate will appear less absurd, although it conveys no correct idea of superficial extent. The distance from the foot of the Glacier du Bois to the top of the Glacier de Lechaud might probably be traversed in six or seven hours, and by the other branch to the Col du Géant, supposing that the state of the glacier permitted the traveller constantly to advance (which is not the case) in about nine. The shortest linear distance from the foot of the glacier to the highest ridge of the Alps is by my survey about seven miles, and the breadth of the glacier seldom if ever exceeds two-thirds of a mile, but is generally much less. This does not give any idea of its apparent extent. The toil of traversing it, the endless *détours*, and the recurring monotony of its crevasses, exaggerate inconceivably the distance, even to those most inexperienced.

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We commence our survey at the foot or lower end of the glacier, proceeding upwards.

The view of the lower end of the Mer de Glace, from the road leading from Chamouni to Argentière, is exceedingly striking. The valley of Chamouni is here broad and flat. Three hamlets of small size are planted in sight of one another, Les Praz, Les Tines, and the Hameau des Bois. The latter is almost in contact with the glacier; and, indeed, in 1820, it attained a distance of only sixty yards from the house of Jean Marie Tournier, the nearest in the village, when its farther progress was providentially stayed. The valley down which the ice pours, meets that of Chamouni at a great elevation: the western side of the glacier (in contact with the Montanvert), presses right upon the verge of a precipice, down which fragments of ice are precipitated at all seasons, whilst the eastern stream, following a gentler slope of ground, sweeps more gently round the foot of the Aiguille du Bochard, and beneath the station called the Chapeau, when it is again diverted to the west, partly by the accumulation of its own moraine in front, and partly by a projecting rock of a remarkable kind, of which we shall immediately speak. From the village of Les Praz, then, this cascade of ice is seen directly in front, but the source of the Arveiron, at its lower extremity, is hid by the mass of the moraines.* The source offers, however,

* It occasionally happens when the glacier is unusually large that the sub-glacial torrent finds an egress at the brow of the precipice above mentioned, and dashes down it in a fine cascade. This occurred in 1846, and I believe once since.

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nothing extremely remarkable, except, indeed, to those who visit a glacier for the first time, and the views which have been given of it are in general exaggerated: It is an arched cavity, almost annihilated in winter, and gradually increasing as the season of waste and avalanches advances, until it forms an archway of considerable height and width, from which the turbid stream of the Arveiron flows. The quantity of water varies excessively at different seasons, and even, I have been assured, on different days. It is fullest, I think, in July; and, in winter, though small, I am assured by natives that it is very far indeed from altogether ceasing, retaining, I was informed, at least half as much water as when I saw it in September, when I estimated the discharge very rudely (it does not admit of exactness) at three hundred cubic feet per second. The source of this water in winter, when the glacier is frozen, may be partly from the heat of the ground in contact with the ice, as supposed by De Saussure, but it must also be recollected that the ice valley of the Montanvert may be supposed to have a due proportion of springs taking their origin in the interior of the earth at a depth to which even the cold glacier-contact does not communicate a sensible influence, and the source of the Arveiron is the natural drainage of the springs of that valley.

The final slope of the Glacier du Bois has a vertical height of at least 1800 feet (the height of the summit called Le Chapeau, above the valley at Les Tines), down which, as has been said, the ice descends half

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shattered, half continuous, twisted into wild shapes, and traversed by countless fissures, whilst on the right the precipice above the source of the Arveiron raises its bare forehead without even a stunted tree or a blade of grass, for its surface is continually furrowed by avalanches, and its hollows washed clean by foaming cascades, which both originate in the diadem of jagged pinnacles of ice by which it is surmounted. To the right and left the prospect is enclosed by the warm green fir woods which touch either moraine* of the glacier, and behind and aloft the view is terminated by the stupendous granitic obelisk of Dru, which has scarcely its equal in the Alps for apparent insulation and steepness — a monolith, by whose side those of Egypt might stand literally lost through insignificance.

When we approach the foot of the glacier at the Hameau des Bois, we are at no loss to perceive that the ice has retreated. The blocks of the moraine of 1820, in which year the glacier made its greatest incursion (in modern times) into the valley, lie scattered almost at the doors of the houses, and have raised a formidable bulwark at less than a pistol-shot of distance, where cultivation and all verdure suddenly cease, and a wilderness of stones of all shapes and sizes commences, reaching as far as the present ice. The limit of the moraine of 1820 is marked in the map, whence

* *Moraine*, the heap of transported masses of rock deposited by a glacier at its sides and termination; also often found on its surface.

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it appears that the form of the extremity of the glacier was not very different from the present one, only that it swelled out more, and that it very nearly had divided itself into two streams, separated by the promontory marked Côte du Piget. This promontory commands an excellent view of the extremity of the glacier. Upon its southern face the glacier has spent its strength, heaping ridge upon ridge of its moraines against it. The northern slope is perfectly protected, and trees grow to the foot of it. One cannot help being reminded of the position of the Hermitage of St. Salvador, on Mount Vesuvius, round which the lava streams pass innocuous.

But this hillock has an especial interest. Its resistance to the pressure of the ice led me to suspect that it is composed of firm materials, and is not merely a heap of rubbish. And so it proved: but whilst the cliffs above the source of the Arveiron are of gneiss, whose beds dip inwards towards the axis of the chain at an angle somewhere about 30°, this hillock is of stratified limestone dipping similarly *under* the gneiss, and at about the same angle.

The moraine of 1820 rises some way upon the slopes which border the east side of the terminal part of the glacier. But when we come to examine these slopes themselves, we find in them indubitable evidence of their being real moraines of a former age, left by the glacier when it had a greater extension than at present. It is the convex escarpment seen in the map to traverse the valley of Chamouni above the village of Les Tines,

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presenting its convexity towards Chamouni. Its length, reckoning from the existing glacier, was estimated by De Saussure at 1300 or 1400 feet; but by the map it would appear to be 6000 feet, or above a mile, reckoning from the rock of the Aiguille du Bochard to the opposite side of the Arve from Lavanchi.

There can be no reasonable doubt that this mound was once continuous, and obstructed the course of the river. Of this we have a farther evidence in the deposit of the alluvial flats which succeed it in ascending the valley towards Argentière, evidently formed by the waters of a lake; and just at the margin of these, close to the eastern side of the mound, the village of Lavanchi now stands.

The summit is a long narrow ridge, sloping rather steeply both ways, and garnished with huge blocks on its very top. The largest of these is marked on the map under the name of *La Pierre de Lisboli*, and in some places these ridges are multiplied and parallel, exactly as in a modern moraine. It will be observed that the ground-plan of this mound is very singular, being convex towards the glacier, instead of concave, as is usually the case. The ice must have descended in such a mass as to have blocked up completely the whole valley, and abutted against the opposite slopes of the Flagère. So great was its mass, and so nearly level the valley of Chamouni into which it descended, that when resisted in front, it spread laterally in both directions, and pushed its moraine up the valley as well as down. The presence of the glacier, obstructing the course of the Arve, produced a

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lake, as in other well known cases. The corresponding moraine on the western or left bank of the glacier is to be sought in a vast terrace of *débris* of rocks belonging to the central chain, over which the mule path from Chamouni to the Montanvert passes for a considerable distance; in fact, nearly all the way from the hamlet of Mouilles to that of Planaz (see the map). The cultivated fields at Planaz point out plainly the terrace-like form of the moraine; and the rapid bend in the lower part of the course of the torrents of Grépon and Fouilly, as seen in the map, is owing to the opposition offered by the mass of *débris* to their direct descent towards the valley. A farther confirmation will be found in the enormous transported blocks which lie some hundred feet above the level of the glacier on its west side near the Montanvert, and which are not, I think, alluded to by any writer.

If we continue our survey of the glacier, ascending the ancient moraine of Lavanchi, we come in contact with the rock a little higher than the Pierre de Lisboli, and the rock here is limestone, as already mentioned.

When we begin to command the view of the glacier in approaching the Chapeau, we are struck by the size of the blocks which seem poised on the projections of the cliff, at a great height above the ice, and which are rounded and scored in such a way as to show that the detached masses were deposited here in the usual progress of the glacier when it attained this height. The view here of the Aiguille du Dru, and of the pinnacles of ice of the Mer de Glace itself, is very striking. A

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portion of the moraine of 1820 is next crossed, and at length, after passing a torrent, we find ourselves at the foot of the hillock called Le Chapeau, on the precipitous side of which is a cavern affording some shelter, and an excellent view not only of the glacier, but of the valley of Chamouni which it commands, and the effect is extremely beautiful, especially in the evening. This spot, although extremely easy of access, is rarely visited by tourists, unless at seasons when the Montanvert is too much enveloped in snow to be conveniently reached; but the two views have very little resemblance, since the portion of the glacier seen from the Chapeau is the lower part, or Glacier du Bois, whilst the upper part, or Mer de Glace, is commanded from the Montanvert, and the other is nearly concealed.

Beyond the Chapeau, the precipices of the Aiguille du Bochard actually meet the glacier, where it tumbles headlong from the rocks, and both seem to forbid farther passage. Nevertheless it is practicable, keeping the face of the rock, to continue the ascent along the east bank of the glacier; and indeed there is scarcely any part of this bank of the Mer de Glace, as high as the foot of the Aiguille du Moine, which I have not traversed. The rocky precipice alluded to would be very difficult to pass, were it not marked by rude steps cut here and there in the soft steatitic rocks, which mingle with the gneiss, and which, being continually wetted by trickling rills, are very slippery. The goat-herds are in the habit of continually passing, and there is nothing to daunt any tolerable mountaineer, although the spot has acquired

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the name of the *Mauvais Pas*, which it bears more frequently than its proper one of La Roche de Muret. This rock (which is exactly opposite to the extreme promontory of the hill of Montanvert on the west side) forms one of the barriers of the *Mer de Glace* above, past which it pours down the precipice in the manner already mentioned. Consequently, when the height of the Roche de Muret has been gained, we have a new reach of the glacier in view, and the ice begins to assume a connected and consistent appearance, although still so excessively full of crevasses as to be generally impassable but for a very short distance. But the ice is here the real icy mass of the Mer de Glace, whilst below, it has been tossed and twisted so as to be entirely remoulded, and to bear none of its original impress. At the point at which we have now arrived, the glacier may be compared to the inclined, dark, unruffled swell of swift water, rushing to precipitate itself in a mass of foam over a precipice; it has all the forms of a compact moving mass of ice, although rent asunder across its breadth by the rapid depression of the bed along which it is urged.

The promontory of the Roche de Muret gained and passed, the slight bay behind has, as usual, been partly filled up by accumulated moraines, upon which we now walk, instead of on the solid rock. Somewhat farther on a noisy, foaming torrent, called Le Nant Blanc, descends from a small glacier, called *Le Glacier du Nant Blanc*, lodged in a ravine interposed between the Aiguilles of Bochard and Dru; this torrent is well seen from the Montanvert—it is most copious in July, and its appear-

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ance is a good index to the state of temperature in the higher regions, instantly diminishing with the first cold nights of autumn. A second torrent descends farther on from the glacier at the foot of the Aiguille du Dru, and beyond this are some fine pasturages, which extend along the foot of the jagged and rocky chain between the Dru and the point of Les Echelets marked in the map. Here, on the higher part of these grassy slopes, near the promontory of Les Echelets, are the highest stunted pines and larches, which occur on either side of the Mer de Glace. From amongst them, now and then, some grand peeps may be obtained of the Aiguille du Dru, which shoots almost vertically above the eye like some tall steeple—pointing to the deep blue sky.

These pastures are worthy of notice from one circumstance, namely, that they are grazed by *cows* for a good many weeks in summer. How a cow can find footing among such rocks, or ascend and descend pathways which might be pronounced disagreeably precipitous by even a not fastidious traveller, and whose zig-zags are often not half the length of the animal's body, may appear sufficiently surprising;—but it is nothing compared to the seeming impossibility of ever bringing them there at all, or removing them. To traverse the Mer de Glace opposite the Montanvert, is at all times a feat of some difficulty for an unloaded man; it is commonly said that there exists but a single practicable pathway amongst the crevasses. That this is not correct, and that it varies much at different seasons, I know from experience—but

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at all times it requires an expert iceman (a correlative word to seaman or rocksman, may perhaps be admitted) to effect this passage with certainty and alone. I remember to have found some stray goats, which had wandered from the shore, quite lost amidst the wilderness of crevasses, and bleating for help.* The only other access to this pasturage is by the Roche de Muret, and there, most certainly, no animal heavier than a goat or a man could make its way unaided. The most usual way of transporting the cows is by the glacier at the foot of the Mauvais Pas, where I have already said the ice is in the very act of tumbling headlong down. There, by the aid of hatchets and planks, a sort of rude pathway is constructed the day before the ascent or descent of the cattle is to be performed, and then about thirty peasants assemble to pass as many cows, and by the aid of ropes succeed, usually without any loss, in compelling the poor animals to traverse the rude gangways which they have prepared. The cows were taken to the valley in the end of September last, and I regretted extremely that I missed the opportunity of witnessing so singular a cavalcade.

The crevasses of the western and middle part of the Mer de Glace below the Montanvert are very continuous and straight, and some of them extend for at least half

* Cattle are sometimes taken across the glacier at this place, and one of the hotel-keepers at Chamouni recounted to me a curious history of the risk which he and a companion had run in transporting a mule. They were assisting him with ropes, and the animal slipping, pulled them both into a crevasse: they escaped with difficulty, abandoning the mule to his fate.

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the entire breadth of the glacier. They are often 15 or 20 feet wide, with walls perfectly vertical, and to move at all parallel to the length of the glacier in this place requires immense *détours*. It is the east side which is so excessively crevassed, and that during the whole length of the *united* stream of the Mer de Glace. Whenever we touch the medial moraine, (the mark of the junction,) there the multiplied and complicated crevasses begin. The reason I believe to be this: the glacier which forms the greater or western portion, which is derived from the Glacier du Géant, moves fastest, and has by far the greater mass. The other, from the Glacier de Léchaud uniting with it, is compelled to follow, or rather accompany it. It is therefore drawn out, and at the same time squeezed into very much narrower limits, as the united stream is forced through a space not greater than the larger alone had before occupied,—just as when two rivers unite, the smaller and weaker is thrown into turbulent eddies by the union with the swifter and more powerful.

Turning now to the western side of the Mer de Glace in its inferior part, but a few remarks occur. The usual path from Chamouni to the Montanvert, and the steep ascent of La Filia,* from the source of the Arveiron, require no particular mention, but the examination of

* I do not know the origin of the name. Thinking that it might refer to some legendary story of a young woman lost at the source of the Arveiron, I once asked a native of Chamouni its meaning, to which he replied, simply enough,—"Je ne sais pas si ce n'est parcequ'on y *file* tout droit," which all who have *descended* it will readily admit to be the case.

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the promontory north of the châlet of Montanvert is not without interest. It is possible there to get a little way upon the glacier, amongst the immense fissures which precede its abrupt descent; and from this icy platform a fine view of the valley is attained. The ice here is remarkably pure, and the fine blue caverns and crevasses may be as well studied as in almost any glacier in Switzerland. Of the cause of this colour I may observe once for all, that I consider it to be the colour of pure water, whether liquid or solid; though there are no doubt conditions of aggregation which give it more or less intensity, or change its hue. But this has a parallel in very many cases not considered as paradoxical. Most bodies when powdered have a different hue than when crystallized and compact, the topaz amongst solid bodies, and the solution of iodide of starch amongst fluids, change their colour with temperature, and many bodies change their tint with their consistency, or lose it altogether when mixed with grosser matter. During an expedition which I made upon the ice in the month of September, during a snow-storm, I observed that the snow lying eighteen inches deep exhibited a *fine blue* at a small depth (about six inches) wherever pierced by my stick. Nor could this possibly be due to any atmospheric reflection, for the sky was of a uniform leaden hue, and snow was falling at the time.*

* On the Colour of Pure Water, see NEWTON, *Optics*, Book I. Part ii. Prop. 10; HUMBOLDT, Voyages, 8vo, ii. 133; DAVY, *Salmonia*, 3d edit. p. 317; ARAGO, *Comptes Rendus*, 23d July 1838; COUNT MAISTRE, *Edin. New Phil. Journal*, vol. xv.

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The west bank of the Mer de Glace is here extremely steep, though not absolutely precipitous. It is clothed with grass and rhododendron, and in many places with spruce firs of considerable size. Amongst these lie fragments of transported granite, wherever a ledge exists sufficient to maintain them, and they are accumulated especially at the promontory at the foot of which the glacier still sweeps, though at a great depth below. On the steep side of the hill facing the valley of Chamouni, and therefore sheltered from the glacier, these masses are comparatively rare. They extend quite up to the

Transported blocks at Montanvert.

dwelling of the Montanvert, a height of 240 feet above the glacier, and even somewhat higher; but the limit is perfectly well marked; for although the rocky ridge which descends from the Aiguille des Charmoz to the Montanvert (and which is here called simply Les Charmoz) is covered with vast debris, these debris are all *in situ*, and in contact with the native rock, a slaty talcose gneiss. These blocks constitute, therefore, an undoubted moraine, corresponding to that of Lavanchi and

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Tines on the east side, and indicating the maximum level of the glacier in very remote times. I may add, too, for the sake of connection, that the fixed rocks in the immediate neighbourhood of the house of the Montanvert, exhibit clear traces of being rounded and furrowed, though too much weathered to exhibit any thing like polish. Such rocks occur on the descending path to the glacier.

The earliest habitation on the Montanvert is thus described by De Saussure :—" Mais où couche-t-on sur le Montanvert? On y couche dans un château; car c'est ainsi que les Chamouniards, nation gaie et railleuse, nomment par dérision la chétive retraite du zerger qui garde les troupeaux de cette montagne. Un grand bloc de granit, porté là anciennement par le glacier, ou par quelque révolution plus ancienne, est assis sur une de ses faces, tandis qu'une autre face se relève en faisant un angle aigu avec le terrein, et laisse ainsi un espace vuide audessous d'elle. Le berger industrieux a pris la face saillante de ce granit pour le toit et le plafond de son château, la terre pour son parquet; il s'est préservé des vents coulis, en entourant cet abri d'un mur de pierres séches, et il a laissé dans la partie la plus élevée un vuide ou il a placé une porte haute de quarante pouces et large de seize. Quant aux fenêtres, il n'en a pas eu besoin, non plus que de cheminée; le jour entre et la fumée sort par les vuides que laissent entre elles les pierres de la muraille. Voilà donc l'intérieur de sa demeure: cet espace angulaire, renfermé entre le bloc de granit, la terre et la muraille, forme la cuisine, la

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chambre à coucher, le cellier, la laiterie, en un mot, tout le domicile du verger de Montanvert."—*Voyages*, § 627.

This was in 1778. But it appears that things were soon improved; for, in one of Link's excellent coloured views (published at Geneva, and very superior to all the more recent ones), entitled, "Vue de la Mer de Glace et de l'Hopital de Blair, du Sommet du Montanvert dans le mois d'Aoust 1781," a regularly built cabin, with a wooden roof, is represented, with this inscription above the door:—

"BLAIR'S HOSPITAL.
UTILE DULCE."

From whence I conclude that this hut was built by an Englishman named Blair, between the years 1778 and 1781. At a later period, a small solid stone house of a single apartment, was built at the expense of M. Desportes, the French Resident at Geneva,* having a black marble slab above the door, with the inscription, *A la Nature*. On my first visit to Chamouni this was the only building, but soon after a much more substantial and effectual shelter was erected at the expense of the *Commune* of Chamouni. The principal floor consists of an ample public room, a small kitchen, a

* Ebel gives the following account of it:—"M. *Bouritt* de Genève, l'aubergiste *Terraz* et les guides *Jacques des Dames* et *Cachat le Géant* ont exécuté le plan de M. *Désportes*. Le bâtiment offroit une grande salle pourvue d'une cheminée, de deux fenêtres, de quatre lits de sangle, avec des chaises, des tables, des glaces, &c. Les frais de l'établissement montèrent à 95 louis."—*Guide du Voyageur*, 1810. Tom. ii. p. 364.

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guide's room, and three bedrooms for strangers, besides accommodation below for the servants of the establishment, of whom two or three remain here for four months of the year. This establishment, though simple and unobtrusive, is sufficiently comfortable and cleanly, and I should be very ungrateful not to acknowledge the kindness and attention which I uniformly experienced during many weeks' residence in this house in 1842; cold and desolate it certainly was occasionally—in September the thermometer fell to 39° F. in my bedroom, and there was little choice of provisions beyond the excellent mutton of the Montanvert; yet, on the whole, I preferred the tranquillity of the arrangements to the bustle of the hotels of Chamouni, whither I seldom resorted but under stress of weather.

We are almost tempted to forget that a view so universally seen, and so often described, as that from the windows of the Montanvert, loses none of its real majesty in consequence of the ease and familiarity with which it is visited by thousands of travellers. For myself, repeated visits, and a long residence, have only heightened my admiration of this, certainly one of the grandest of alpine views. The Aiguille du Dru has in its way scarcely a rival, and there are very few glaciers indeed with a course so undulating and picturesque as the Mer de Glace, and with banks so wildly grand, of which the general effect can be so well seized from any one point.* Besides former visits, I have

* It may be seen to most advantage from a station some hundred feet higher on the Charmoz.

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this year seen it under every circumstance which could enhance its sublimity; under the piercing glow of the

almost insupportable midsummer's sun, and again in the snowy shroud of premature winter,—in the repose

Moraine near the Montanvert, Chamouni.

of the stillest and serenest moonlight; and lit up at midnight by the brilliancy of almost tropical lightning.

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The glacier immediately below the Montanvert is easily accessible, whilst it presents at the same time all the grander and more remarkable features of glacier ice. The moraine is abundant, and the crevasses moderately large. A few hundred feet farther down there was this year (1842) a mass of travelling rock of enormous dimensions upon the ice. A sketch of it is given here. Its position, which is accurately fixed on the map, (where this block is marked D 7) will define the motion of the glacier in future years. There is a footpath here along the moraine, which is a steep stony ridge, about thirty feet high on the landward side, and much more towards the glacier in its present state. The masses of which it is composed, and indeed of all the older moraines of this neighbourhood, are not larger than those which are at present to be seen on the surface of the glacier.

A large block of protogine (granite) on the moraine is traditionally pointed out as the farthest spot reached by Wyndham and Pocock, the explorers of Chamouni in 1741, and thence called the *Pierre des Anglais.* Since this chapter was originally written, it has been (1848) maliciously split by fire.

Proceeding upwards in our survey of the Mer de Glace, we find a footpath which conducts us from the house of the Montanvert, first nearly down to its level, and then parallel to its length. By and bye we come to pretty smooth faces of rock, which go down sheer under the ice, and whose exposed promontory is now visible, ground away by the friction of the ice, or rather of the

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mass of abraded rocks mixed with sharp stones and sand which it drags along with it. To cross this rocky face, some rude steps are cut in the slaty gneiss, and the two passes of this description are called the *premier et second Ponts*. De Saussure mentions (§ 628) having employed two men to blast the rocks to facilitate this passage, and the marks may still easily be seen. Opposite to this promontory the glacier is greatly heaved and contorted, owing probably to the inequalities of its bed. It is not easy to estimate the magnitude of these icy hillocks or waves, as they have been termed. This arises chiefly from the enormous magnitude and great angular elevation of the peaks and wild rocks beyond.

I had a proof of this one day on the rather rare occasion of a fog settling down to near the level of the glacier, which enveloped entirely the scenery of the farther bank. Then the icy inequalities seemed to rise to mountains, and it was difficult to persuade oneself that the glacier, like the ocean, did not now and then raise its billows in a storm, to twice or thrice the height which continual observation had made so familiar. It might be easily, and indeed is generally supposed, that the glacier is here impassable; but on the 18th September 1842, I crossed it with Balmat, and found it less difficult than the oblique traverse we subsequently made to return to the Montanvert.

Having passed the second "Pont," the path descends to the moraine, which partly fills a sinuosity in the outline of the hill; and having followed this for some hundred yards we are met by a perpendicular cliff, the foot of

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which is abraded by the ice. This is the point marked *L'Angle* on the map, nearly opposite to the promontory of Les Echelets, formerly mentioned. Here there is no alternative but to descend upon the ice, and its contact with the rock offers some peculiarities worth observation. When the ice of the glacier, in the course of its progress downwards, has been forced against an opposing promontory of rock, and has passed it, it will easily be understood that a cavity will be left behind the promontory which the ice does not immediately fill up. Here it is easy (occasionally at least) to descend into such a cavity, with a wall of ice on the left hand and of rock on the right. Between the two are wedged masses of granite, which have slipt from the moraine between the ice and rock, and which, pressed by the incumbent weight of the glacier, and carried along in its progress, evidently must, and really do, wear furrows in the retaining wall, which is all freshly streaked, near the level of the ice, with distinct parallel lines, resulting from this abrasion. The juxta-position of the power, the tool, and the matter operated on, is such as to leave not a moment's doubt that such striæ must result, even if their presence could not be directly proved.

The *Angle* is the point noticed by De Saussure as the junction of the true granite with the rocks of gneiss. It is a full half hour's walk from the Montanvert. It was here that in June 1842 I determined for the first time the regular *daily* movement of a glacier.

To advance higher up the glacier, two courses may be taken; either to resume the moraine as soon as the

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promontory has been passed, and thus advance as far as possible along the foot of the Aiguilles des Charmoz, or to follow the glacier near its western border, by an intricate passage amongst the numerous crevasses by which it is traversed. The former is very fatiguing, and not without danger from the frequent fall of stones from the small glacier at the foot of the Charmoz. On one occasion I saw an immense discharge of stones and mud take place, arising from some sudden change in the glacier, with loud noise, which continued for several minutes. The passage of the Mer de Glace almost requires an experienced guide. I know of no better instance of the confusing monotony of the glacier surface, and the kind of skill required to retrace one's steps on the ice, than the passage of the Angle. The crevasses are so multiplied, yet so similar, that each seems to rise endlessly "another yet the same." We continually fancy that we recognise a particular feature, which is perhaps a hundred times repeated, with the slightest possible variation of form. Once strayed from the right path, it is difficult to find it again, because a false turn may separate us from the region we are endeavouring to reach by impassable crevasses. Consequently, the guides, who very frequently pass during the season in conducting travellers to and from the *Jardin*, resort to piling stones here and there upon the ice, or upon blocks, as land-marks, such as are used occasionally on moors or hills subject to fogs. Even one who has great facility in retracing a path once pursued on solid ground, or in discovering a track for

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the first time, finds himself here quite at fault; and I have frequently known experienced guides of Chamouni go astray, and lead travellers into difficult and embarrassing situations, or place landmarks in altogether wrong positions, so as to mislead future passers by. I suppose that I passed the Angle at least forty or fifty times in 1842, and although I at last became pretty well acquainted with its intricacies, yet it was impossible to extricate oneself mechanically, or without vigilant attention. M. Bourrit has given a just and not exaggerated description of similar difficulties. "Rien ne peut donner une idée du nombre prodigieux des crevasses de cette vallée, que la difficulté d'en sortir. Il n'est jamais arrivé de retrouver au sortir le même banc de glace par où l'on est entré; souvent, au contraire, l'on erre pendant trois quarts d'heure, et les guides étonnés, recourrent aux enchantemens pour expliquer cet effet de la multiplicité d'objets semblables et qu'une longue fréquentation n'apprend point à distinguer."* It deserves, however, to be mentioned, as a point not only curious in itself, but highly important in considering the constitution of glaciers, that they present year after year a surface so very similar, that an experienced guide will make his way over the ice in the same direction, and seem to avoid the same crevasses, whilst he is, in fact, walking upon ice wholly changed—that is, which has replaced in position the ice of the previous year, which has been pushed onwards by the progressive movement of the glacier.

* Description des Glaciers, l. 107.

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This is a fact which, though generally enough admitted, has not yet excited sufficient attention. The surface of the glacier has, for the most part, the same appearance as to the variations of level, the occurrence of moraines, the systems of complex crevasses, and the formation of superficial water-courses, in any one season as in another. These phenomena, then, are determined by the form of the bottom and sides of the rocky trough in which the glacier lies, and by its slope at the spot. Just as in a river, where the same molecules of water form in succession the deep still pool, the foaming cascade, and the swift eddy, all of which maintain their position with reference to the fixed objects round which the water itself is ever hurrying onwards. The passage of the Angle is more difficult in some seasons than others, but it probably varies much more in its character between spring and autumn of any one year than between one year and another. This I learned by the unanimous testimony of the guides, and my observations of three different years confirm it.

The Angle past, the most conspicuous object is the imposing Aiguille des Charmoz, which rises on the right. The rocky pinnacles of which it is composed exceed in sharpness those which I have seen in any other parts of the Alps. There is one which is conspicuous from the Montanvert, and which has an unnatural and exaggerated appearance in most of the engravings, which is really as attenuated as it is possible to represent it. The mass is of granite, in which sapphires are found, though rarely, in the *Couloir* im-

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mediately beyond the Angle; I have found a singular porphyritic rock amongst the fragments, containing felspar and epidote, which it is difficult to refer to any class of primitive rocks.

From the foot of the higher summits of the Aiguille des Charmoz, a small glacier, which has been already alluded to, takes its origin. It is one of those short limited glaciers termed by De Saussure, *glaciers of the second order*. They do not essentially differ in structure from other glaciers, but are shorter, owing in all probability to the little surface which they present for receiving snow, and thus increasing their dimensions, as well as to the great angle of inclination of the beds on which they commonly rest. This is, indeed, such as to render their adhesion to the ground an astonishing circumstance. M. de Charpentier has very justly quoted several examples as proving, that if glaciers really slid over the soil, as De Saussure supposed, these could not for a moment sustain their position at an angle of 30° or more. In the higher part of the Mer de Glace, or rather, on the great chain between the Grande Jorasse and Mont Mallet, there are some of the icy masses which seem to hold on to the face of the rocks by mere adhesion, presenting precipices certainly of several hundred feet in height. I have watched these masses day after day, when the sun shone so as to throw the deep shadow of the ice-cliff northwards, giving it a magnificent relief, when the stability of these glaciers appeared little short of miraculous.

A rocky ridge, descending eastwards from the Char-

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moz, composes the massive promontory of *Trélaporte*, round the foot of which the Mer de Glace struggles more violently in its passage than at any other part. The result is a series of fissures, which immediately at the turn of the rock are quite impassable, and which extend radially outwards like the joints of a fan. To pursue the course up the glacier, these crevasses must be crossed nearly at right angles, until the centre of the glacier has been gained, or the great moraine descending from the promontory of the Tacul, which divides the glacier into two portions. We may, however, ascend the promontory of Trélaporte itself, which commands a very interesting view.

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CHAPTER VII.

DESCRIPTION OF THE MER DE GLACE OF CHAMOUNI—CONTINUED.

Trélaporte—A traveller crag-fast amongst precipices—The moraines of the Mer de Glace—"Moulins"—Discovery of De Saussure's ladder—Tacul—Lake—Bivouac under a rock—Thunderstorm—The chamois hunter—Superb glacier table—Glaciers of Léchaud and Talèfre—Jardin—Pierre de Beranger.

No part of the valley of the Mer de Glace shows better than the Trélaporte the abrading action of the ice upon the rocks, or the height to which the glacier has evidently once risen. The forms are everywhere smoothed and rounded. Vast sheets of bare granite, nearly vertical, and without a fissure, occur up to a great height, and a few hundred feet above the glacier level is a sort of shelf, covered with large detached masses of granite, which have formed an ancient moraine. On the top of one of these, my surveying station G was planted. There is something singularly desolate about the appearance of these rocks, broken here and there by a tuft of grass, which adheres in the midst of an inaccessible precipice; and as a few sheep pasture here every year, without any resident shepherd, these poor animals

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straying in search of food, perish in considerable numbers from famine, or by falling down the cliffs. A singular incident occurred here in the past autumn, which shows the danger of venturing into such places without a guide, or at least an attendant.

On the 17th September 1842, I walked up to this lonely promontory, which, as it leads no where, is unfrequented, except by the occasional visit of the shepherd, to carry salt to his sheep.* Having stopped to sketch the bold outlines of the *Dru* and *Moine*, which form the opposite boundary of the glacier, I sent Auguste to seek some water, which, owing to the form of the rocks I have mentioned, it is difficult to find. I was not surprised that he did not immediately return, but when, having waited half an hour, and finished my sketch, I saw nothing of him, I began to fear that he had got entangled amidst these wild rocks, and proceeded in search of him. After some time I saw him coming up with two lads of Chamouni, whom we had seen start from the Montanvert in the morning, for the Jardin, and leading between them a man evidently exhausted, confused, and his clothes torn to rags. On approaching, I found Auguste scarcely less excited than the man he led, and to rescue whom from a ledge of rock, on which *he had passed the whole night*, he had placed himself in imminent danger. This person

* Accordingly, here and elsewhere, a traveller may be incommoded by the importunate earnestness with which the sheep surround and follow him, supposing that he has brought salt with him. They are as tame as domestic animals.

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proved to be an American traveller, who had wandered all alone the morning of the day before over the hill of Charmoz, above the Montanvert, and scrambled as far as the solitary precipices of Trélaporte, unvisited, as we have said, except casually by a shepherd, and still more rarely by some chamois hunter. Towards afternoon (by his own account) he had slipped over a rock, and being caught by the clothes on some bushes, had his fall checked so as to gain a little ledge surrounded by precipices on every side, where he found himself lodged in a perfectly hopeless prison. Here he passed the whole night, which, fortunately, was not cold, and in the morning he succeeded in attracting, by his cries, the young men of Chamouni, who were on their way across the glacier, at a great distance below. The two boldest, with difficulty, climbed, by a circuitous path, so as to gain a position above him; but their united efforts would have been unequal to rescue him had I not providentially gone, with my guide, the same morning, to this remote spot. Whilst he was on a search for the water which I required, he came within sight of the boys, vainly attempting to extricate the traveller. Balmat instantly joined them, and by great personal courage, as well as strength, succeeded in dragging the man up by the arm, from a spot whence a chamois could not have escaped alive. Balmat told me, that whilst he bore the entire weight of the man on the slippery ledge to which he himself clung, he felt his foot give way, and for a moment he thought himself lost, which was the cause of the very visible emo-

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tion of which he bore traces when he joined me. I gave wine and food to the traveller, and the others, and especially applauded the humanity and courage of the lads, one of whom conducted the traveller back to Chamouni, for his nervous system was greatly affected, and for a time I doubted whether he was not deranged. I returned with Balmat to view the exact spot of the adventure, and a more dreadful prison it is impossible to conceive. It was, as I have said, a ledge about a foot broad in most places, and but a few feet long, with grass and juniper growing on it. It thinned off upon the cliff entirely in one direction, and on the other (where widest) it terminated abruptly against a portion of the solid rock, not only vertical, but overhanging, and at least ten feet high, so that no man, unassisted, could have climbed it. The direction of his fall was attested by the shreds of his *blouse*, which were hanging from some juniper bushes, which he had grazed in his descent, but for which evidences it would have appeared to me inconceivable that any falling object could so have attained the shelf on which he was almost miraculously lodged. Immediately below the spot he fell from, the shelf had thinned off so completely that it was plain he must have fallen obliquely across the precipice, so as to attain it. The ledge was about twenty feet below the top of the smooth granitic precipice, to which a cat could not have clung, and below, the same polished surface went sheer down, without a break, for a depth of at least 200 feet, where it sinks under the glacier, whose yawning crevasses

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would have received the mangled body, and never would have betrayed the traveller's fate. A more astonishing escape, in all its parts, it is impossible to conceive. It is probable, that had the young men not crossed the glacier at the fortunate moment, my guide and I would have passed the rock fifty yards above him, (it was in the direction in which we were going) without either party having the remotest idea of the other's presence.*

To return to the Mer de Glace. The foot of the Trélaporte offers several excellent contacts of the ice and rock, which is there, as at the Angle, much worn by the abrasion of the stones or gravel. It is quite practicable to traverse the glacier from hence to the Tacul, or promontory at the bifurcation of the glaciers *du Géant* and *Léchaud.* The usual course of proceeding is, as we have observed above, to cross the glacier before reaching Trélaporte, until the principal medial moraine is attained. The whole of the eastern part of the glacier is here much lower than the western, which is heaped up against the promontory, and the effect is to squeeze the moraines together into the smaller or eastern portion of the glacier. The regular curvature and general parallelism of these moraines, amidst all this confusion and dislocation, is exceedingly remarkable. From the point we have now reached, upwards,

* From a rocky summit between Trélaporte and the Aiguille des Charmoz, which I have marked G* on the map, a superb bird's-eye view of the glacier is attained. The ascent is laborious and rather difficult.

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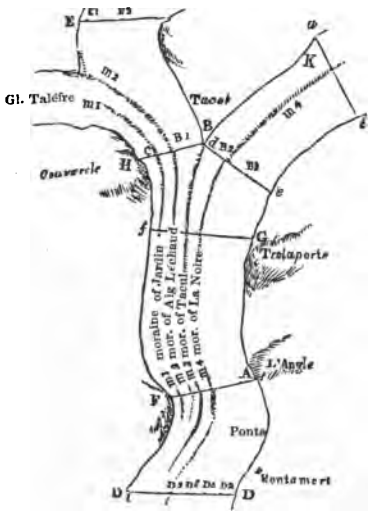
four of them may be most distinctly traced. Two descending the Glacier de Léchaud, one from the promontory of the Tacul, and one the principal medial moraine



of the Glacier du Géant, which descending from the promontory called La Noire, (see the map,) we shall designate by that name. Of the first two, one descends all the way from the foot of the Courtes, on the Glacier du Talèfre, and the other is the medial moraine of the Glacier de Léchaud. The two last have a remarkable *dislocation* or lateral displacement, opposite to Trélaporte, which arises from some cause which I am unable to determine. Nor do I know whether this

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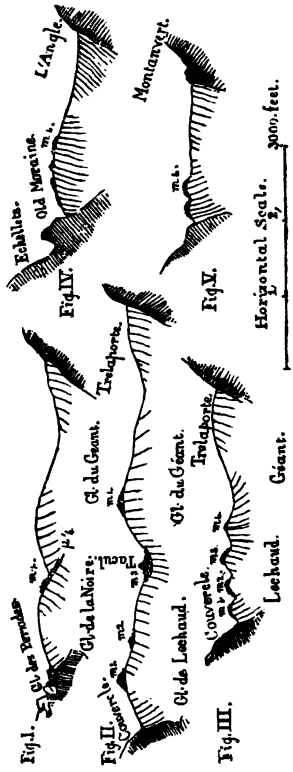
apparent dislocation advances with the progress of the glacier.*

Near the same spot are the "Moulins," which the guides always take care to point out to travellers going to the Jardin. They are deep and nearly cylindrical holes in the ice, into which the water, accumulated in the rills which form the superficial drainage of this part of the glacier, is precipitated in a more or less copious cascade according to the season. Sometimes these cascades are double in the same hole, or one stream separates into two cascades; but always, *whatever be the state or progress of the glacier, these cascades or "Moulins" are found in almost exactly the same position*, that is, opposite to the same fixed objects on the side of the glacier.



* I have reason to think that the dislocation is permament, and due to the overpowering pressure of the ice from the branch of Le Géant. (1854.)

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This is an evident proof of the continued renewal of the glacier as to its state of aggregation, the external forms remaining fixed, whilst the integrant parts are advancing.

I was greatly struck by the change which I perceived in this part of the glacier between the month of June, when I first visited it last season, and the close of September, when I quitted it. At the former time the crevasses were comparatively trifling, and they continued to open more and more the whole summer, so that at the end many places were nearly impassable, which earlier I had traversed without difficulty. This is a most important fact, for it shows that during winter the glacier consolidates, and that every summer its crevasses open afresh, whilst its continued adaptation to the external constraint which its walls or bed impose, show that the glacier mass is far more passive and plastic than it has usually been supposed. I might have stated that in the lower part of the glacier this is perhaps even more striking, for there, the thaw beginning earlier, and being more complete, the crevasses which have opened in spring attain their widest extension in July and the beginning of August, and afterwards, by the collapsing of their sides, and the general softening of the mass, they subside into rounder forms, and the cavities being partially filled, are more easily crossed.*

* The *Moulins* are probably re-formed every spring (or possibly at longer intervals) by the rill of water which has traversed the unbroken ice of the Glacier du Géant dropping into the first crevasse opened by the rocky inequalities of Trélaporte. The form of the crevasse may be lost by the softening and working of the ice, but the falling water will keep open a vertical shaft. Old shafts abandoned by the water are occasionally seen. (1854.)

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It was nearly opposite the "Moulins,"—that is, between the stations marked G and H on the map, that in 1832, on my way to the Jardin, my guide Joseph Marie Couttet pointed out to me some fragments of wood, evidently much wasted and rubbed, which he assured me were part of the identical ladder which De Saussure had used on his memorable journey to the Col du Géant, forty-four years before. I kept a portion of the wood as a relic, without, however, attaching very great faith to its history; but the inquiries which I made this year (1842) dispose me to believe it probably correct. Couttet and his brother repeated to me exactly the same story as before, and mentioned the year 1832 as that in which the ladder reappeared, and pointed out the very spot where I had myself found it, without having the least idea that I had heard of the thing before. They farther mentioned that there was no question that it was a ladder, for that Captain Sherwill had seen and taken some of the steps still adhering to the lateral props. It was certain that the morsels in question had descended from the Aiguille Noire, or at least in that direction, for this, the most westerly of the medial moraines, has its origin there;* and it is

* The fact that the *origin* of the medial moraines is familiarly known to the guides of Chamouni seems equivalent to a true theory of the origin of these moraines so strangely misapprehended by De Saussure and most of his followers. Since a medial moraine may always be traced up to a promontory, and there be seen to originate, or at least to be combined out of the two lateral moraines which there unite, it would seem impossible to ascribe to them any other than the true origin. And that the Chamoni-

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quite certain that De Saussure descended the glacier on that side, and that he left a ladder at that place; for he tells us that he was unable to pass by the western side of the Glacier du Tacul on account of the crevasses, and Couttet's father was himself on the expedition, and descended from the col with the enormous load of 160 pounds after the termination of the expedition, and he assured his sons that the ladder had been left there. Besides, among the few ascents to the Col du Géant since the time of De Saussure, perhaps every one has been performed by the western side of the glacier, which, as I have said, is the safer and more usual course; and had a ladder been left in that quarter, it could never have reached the medial moraine of La Noire. There is indeed one other alternative—that the ladder had been used by the crystal hunters who used to frequent the rocks of the Aiguille Noire, for the black quartz crystals which perhaps occasioned the name of the spot. But in this case it is more than probable that the Couttets themselves, the most experienced crystal hunters of the valley, would have been aware of the circumstance. On the whole, then, in the absence of any direct information of any other ladder having been left in this particular quarter besides that of De Saussure, it seems reasonable to admit that the ladder in question descended

ards perfectly understand this, is plain from the fact that they seek in each moraine the minerals proper to the source whence it is derived; for instance, the red fluor spar in the most easterly moraine of the Glacier de Léchaud, which has descended the Talèfre, and has its origin at the foot of the rocks called Les Courtes, where this rare mineral is sought *in situ*.

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from the Aiguille de la Noire to the point in question, near the Moulins, between the year 1788 and the year 1832. The observation is interesting, as determining so far the mean motion of the glacier in the interval. By the map, the distance, allowing for the sinuosities of the glacier, appears to be about 13,000 feet, which being travelled in forty-four years, gives 300 feet *per annum* for the mean motion of this part of the glacier.

A little higher up we stand in the centre of three valleys, and in the most extensive part of the Mer de Glace. The guides believe, and probably with reason, that it is here deepest. They assure me that they have sounded a "moulin" of above 350 feet deep. What is perhaps as good a proof as any of the mass and solidity of the ice is, that I have seen enormous crevasses and basins holding still water, and therefore completely closed below. The water was of an exquisite blue colour, independent of the colour of the ice.* The view from the centre of the glacier in fine weather is one of the finest which can be conceived.

In order to reach the promontory of the Tacul, where the glaciers divide, it is usual to cross the fourth and third moraines (I will in future designate them by numbers counting from the east) and in the centre the glacier is here easily traversed. The Tacul is reached commonly in three hours from the Montanvert, but a practised walker will do it in two, and I have descended in much less. The union of the two glaciers is attended

* I have described it in my Journal as "nearly or quite as blue as the Rhone at Geneva."

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with some circumstances worthy of notice. That descending from the Géant is by far the most powerful one, and the other is forced to yield somewhat to its pressure. The mass of rock forming the lateral moraine of the Glacier de Léchaud is, however, the most considerable, and this is wildly tossed up into a lofty medial moraine at the meeting of the ice streams. The Glacier de Léchaud clings, as it were, to the rocky wall of the promontory—the Glacier du Géant has thrown up a vast mound of debris, which prevents it from approaching the rock within some hundred feet, and leaves a hollow between, part of which is faced by a huge icy barrier, of considerable elevation and difficult to scale. In this hollow—between the edge of the Glacier du Géant and the promontory of Tacul—there exists at certain seasons of the year a small lake. I first visited it in 1842, on the 25th June, when it contained no water; but a few days of continued hot weather, by melting the ice, filled it, and it remained more or less full during the remainder of the season. I have seen it, however, vary exceedingly in level from one day to another, so that there can be no doubt that it has an outlet through the moraine under the glacier. Balmat affirms that the source of the Arveiron is seen suddenly to burst forth with great vigour, and that this is attributed to the emptying of the *Lac du Tacul*—which is by no means impossible. It appears from the testimony of M. Bourrit (*Voyages*, i. p. 90), that De Saussure was the first stranger who reached the Tacul.

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The point marked B on the promontory of the Tacul was one of my principal stations, commanding an extensive view of nearly the whole glacier. It was at a height of 277 feet above the lake, so that the view embraced not merely the three branches of the glacier, but that of Talefre, the Jardin, and the mountains beyond, and a portion of the valley of Chamouni opposite the Montanvert, the range of the Aiguilles Rouges, and the snowy summit of the Buet peeping over beyond.

Near the side of the lake, at the foot of the promontory, lies an enormous block of granite belonging to the moraine of Léchaud. The cavity beneath its southwest side is a well-known refuge for chamois hunters, and for the few travellers who pass the Col du Géant, who usually save from two to three hours of laborious walking by sleeping here instead of at the Montanvert. It is, in fine weather, a pretty tranquil spot. The glacier is in a great measure concealed by its lofty embankments, which shelter it from the chillest winds. The slopes round are grassy, and diversified with juniper bushes, and the little piece of water, when unfrozen, has a cheerful effect. Here I spent two nights with Balmat, with a view to advance my survey and the experiments on the ice; for whilst pursuing my inquiries on the higher glaciers, it was found to make a most fatiguing day to ascend so far from the Montanvert (carrying instruments and food) before the day's work could be begun, and to return again in the evening. Day after day I have been out thus from ten to thirteen

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hours upon the glacier. A bivouac was, in favourable weather, a preferable alternative. The juniper bushes afforded a cheerful and serviceable fire, and with the aid of a chamois skin to protect me from the damp ground, and a strong blanket hastily sewed into the form of a bag, in which I slept, the nights passed not uncomfortably. But, on both occasions, when I meant to have passed some days here, I was forced to descend from the bad weather, against which we had no sufficient protection, the cavity under the stone being quite open in front.

The last time that we were driven from this poor shelter was on the 6th August, when a day of unnatural mildness was succeeded in the evening by the most terrific thunderstorm I have ever witnessed. We were overtaken by it, and thoroughly drenched, before we could reach the Montanvert; but after sunset it raged with the greatest fury. From the windows of the little inn, I watched with admiration the whole scenery of the Mer de Glace, lit up by the explosive lightnings which followed for some hours with little intermission, whilst the frail building seemed to rock under the fury of the gale, and vibrate to every peal of thunder. Each tiny torrent now gave tongue increasingly, until the fitful roar became a steady din, with now and then a crash arising from the discharge of stones hurried along by the flood, or an avalanche prematurely torn from the glacier of the Nant Blanc. It was Saturday night, and Balmat had gone down to Chamouni to attend mass next morning. He told me

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afterwards that the dazzling effect of the lightning was such, that it was with the utmost difficulty he could keep the familiar path from the Montanvert, and that he wandered, drenched to the skin, as if blindfold, through the wood. Next day brought tidings of disasters from the valley. The road at Les Ouches had been broken up by the torrents, so as to be impassable; many cottages were filled with stones and gravel, and deserted by the inhabitants; and I believe some small barns were carried away—but no lives were lost.

One night I had a guest in my rude shelter. It was a poor man of Chamouni, who, impelled by an irresistible passion for the chase, came to pass the night on the glacier, in hopes of finding his game in the morning; a nearly hopeless task,—for the Mer de Glace is now so completely bereft of chamois, that, during the whole summer, I do not recollect to have seen more than two upon it, though on other less frequented glaciers I have seen whole herds. The *chasseur* was very poor, and by no means young; he gladly partook of the provisions which I could spare; and learning that he was a respectable man, though unsettled in his habits, I could not but feel an interest in the singular ardour with which he pursued his thankless toil: Truly might he say with the hunter in Manfred—

> her nimble feet
> Have baffled me; my gain to-day will scarce
> Repay my break-neck travail.

The poor fellow owned the infatuation of what he called his "malheureuse passion;" but he seemed willing to

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die for it. Late on the afternoon of next day I met him; his sport consisted in having seen a chamois' track, and killed a marmot. By his want of dexterity, however, he had very nearly made a victim of one whom I could ill have spared. Balmat, whilst employed for me on the ice, heard a ball whiz close past him, and looking up, saw our guest of the previous evening behind a rock, whence he had taken aim at a marmot! These animals are very abundant in every part of the higher Alps. They emit a shrill cry like a whistle: they lie torpid in holes a great part of the year, and are valued for their fat. When young, they are eaten.

The chamois hunter seeks the limits of the glacier region in the evening; lies under a rock, as we did, and starts before dawn to watch the known avenues by which the chamois descend to feed. If alarmed, they take to the hill tops—to crags rather than glaciers; there he must follow them, heedless of danger, impelled alone by the excitement of the sport. The day is soon spent in fruitless ambuscades—night arrives—and his previous shelter is luxury compared to what he has now the option of—a face of rock, or leafless bed of debris must be his couch, and his supper is bread and cheese. After a few hours' rest, he repeats his meal, drinks some brandy, and starts again. If the chase be prolonged, physical endurance is pushed to the utmost. A most respectable man of the canton of Berne, who had himself killed seventy-two chamois, assured me that he had wandered thus for three days together,

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tasting nothing but water, which would seem incredible, if we did not recollect that hunger is often repelled for a time by fatigue. De Saussure mentions three hunters, father, son, and grandson, who successively lost their lives in the chase;* but such accidents are, I conceive, now more rare. The value of a chamois is only from twelve to fifteen francs, including the skin, so that it offers little pecuniary temptation to the exposure of life. No doubt, as the historian of the Alps adds, the excitement is the real reward, as in the soldier, sailor, and gamester; and perhaps the naturalist has little reason to express surprise at the risks and privations of the hunter's life, when his own would appear to so many persons much less intelligible.

But to return to the glacier.—Following the eastern branch above the separation at the Tacul, we find ourselves on the glacier de Léchaud. Two conspicuous moraines belong to it, which I have called Nos. 1 and 2.† The first is the medial moraine of the tributary glacier of the Talefre; the other comes from the eastern side of Léchaud, above the union with the Talefre. It is in connection with the former of these moraines, and nearly opposite the promontory of the Couvercle, that there lies upon the ice a very remarkable flat block of granite, which particularly attracted my attention on my first visit in 1842 to this part of the glacier. It is a magnificent slab (marked C on the map, being the position which it occupied in the month of June 1842), of the dimensions of 23 feet by 17, and about 3½ feet

* Voyages, § 736.

† See woodcut, page 138.

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in thickness.* It was then easily accessible, and by climbing upon it, and erecting my theodolite, I made observations on the movement of the ice. But as the season advanced, it changed its appearance remarkably. In conformity with the known fact of the waste of the ice at its surface, the glacier sunk all round the stone, while the ice immediately beneath it was protected from the sun and rain. The stone thus appeared to rise above the level of the glacier, supported on an elegant pedestal of beautifully veined ice. Each time I visited it, it was more difficult of ascent, and at last, on the 6th August, the pillar of ice was *thirteen feet high*, and the broad stone so delicately poised on the summit of it (which measured but a few feet in any direction), that it was almost impossible to guess on what it would ultimately fall, although, by the progress of the thaw, its fall in the course of the summer was certain. The ice of the pedestal presented the beautiful lamellar structure parallel to the length of the glacier. During my absence in the end of August, it slipped from its support, and in the month of September it was beginning to rise upon a new one, whilst the unmelted base of the first was still very visible upon the glacier.

The glacier de Léchaud is on the whole pretty even on its surface—I mean that part which lies to the south-west of the medial moraines. On account of its great

* The motion of this remarkable stone has been since repeatedly examined by me, in 1843, 1844, 1846, and 1850. On the 12th July 1850, it was 2520 feet distant from its first position (June 1842), giving a mean motion of 329 feet per annum.

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elevation, it is covered in its higher part with snow almost the whole year, and until the month of August it offers very disagreeable walking, on account of the half-melted snow on the surface, which likewise conceals the crevasses, and renders it somewhat dangerous. It is joined by some small tributary glaciers from the Mont Tacul. Opposite the glacier du Talefre occur two "Moulins," one of which was remarkable last summer for its great depth and perfect verticallity. About an hour's walk above the Tacul, is station E on the east side of the glacier, whence I watched its motion. It is here just passing into the state of *névé*, which defines the limit of perpetual snow on the surface of the glacier, whilst there is true ice beneath. The view here is very grand. The level is 7926 feet above the sea, and the glacier, almost free from crevasses, is spread out like a magnificent level floor from which rises the tremendous and inaccessible wall terminating the view to the southward, of which the Grande and Petite Jorasses form a part. The Grande Jorasse is the highest mountain of the range next to Mont Blanc, and its northern side is quite precipitous. From the point E, it is seen at an elevation of 30 degrees, the horizontal distance of its summit being less than two miles.

The western feeder of the glacier de Léchaud descends from behind the Mont Tacul from the serrated ridge which connects it with the great Alpine chain. This ridge is called *Les Périades*, and its culminating point, Mont Mallet. From the eastern foot of the pinnacle of Mont Mallet the tributary glacier descends.

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It is pretty extensive, and not wholly inaccessible, for the brothers Couttet assure me that they have thus gained the summit of Mont Tacul from behind, which, at the best, must be a very long and difficult journey.

The higher part of the glacier de Léchaud is scarcely ever visited, except by crystal and chamois hunters. Tourists who venture across the Mer de Glace always make their way to the Jardin, and with good reason, as it offers some of the grandest points of view anywhere to be found on this glacier; nor is there perhaps in the Alps any expedition so practicable in fine weather, which repays so completely the traveller who appreciates the wildest and grandest natural scenery. The traveller to the Jardin does not need to touch the Tacul at all. He crosses two of the medial moraines at the Moulins between Trélaporte and the Couvercle, and higher up he passes the other two, near the great stone, C. It is difficult to approach the lower part of the Couvercle much nearer. I have more than once ventured down the east side of the glacier, under the Aiguille du Moine, towards station F, but the passage is embarrassing, often impossible. When the two glaciers meet (as I have already remarked), the eastern half is dislocated excessively, and is all but impassable. The promontory of the Couvercle itself, opposite C, may be easily reached, and offers some interest from the visible friction to which it is subjected by the descent of the glacier. Farther up, we stand in front of the descending ice of the glacier du Talefre, which presents a majestic and perfectly inaccessible accumu-

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lation of icy pyramids and fragments ejected through the narrow opening which gives vent to the basin of the glacier, which pours over the precipice in a solid cascade, presenting a perfect chaos of forms.

A singular circumstance which came to my knowledge on a subsequent visit to Chamouni (1846), enables us to assign the rate of progress of the glacier down that rocky steep. In July 1836, a guide named Michel Devouassou fell into a crevasse on the glacier of Talefre, whence he extricated himself with difficulty, leaving his knapsack behind him. The spot where this occurred is perfectly well recollected. In July 1846, precisely ten years after this occurrence, fragments of the knapsack and its attachments (now in my possession, and which were recognized by Devouassou himself and other persons) were ejected from the glacier at the foot of the Couvercle. The distance between the points of loss and recovery (which are indicated on the map) is 4300 feet, giving a mean motion of 430 feet per annum. The difference of level is 1145 feet.

The ascent to the glacier du Talefre is usually accomplished by the rocks of the Couvercle at the foot of the Aiguille du Moine. It offers no kind of difficulty. The ascent, where steepest, is called *Les Egralets*. Above these the view becomes wild, but very grand. On the left is the Aiguille du Moine,* one of the most

* Called Aiguille du Talefre by De Saussure.—*Voyages*, § 630. In 1846 I attempted to ascend the Aiguille du Moine, but about 700 feet below the summit was stopped by insuperable obstacles. I was then at an absolute height of 10,360 feet.

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elegant and uniformly conical summits of the chain; at its foot are huge blocks of fallen rock, tenanted by marmots. Looking backwards, we command a large space of the Mer de Glace, and the grand view up the glacier du Géant opens, and Mont Blanc begins to appear for the first time, fortified on this side by the impassable barriers of the Monts Maudits. The Aiguille du Midi, from its height, begins to overtop those of Grépon and Blaitière, and between it and Mont Blanc the rounded form of the Dome de Goûté is not to be mistaken. In front, the wide basin of the glacier du Talefre, in a great measure concealed from the Mer de Glace by its height, and the steepness of its outlet, begins to open. It has a singular and interesting appearance. It is shaped almost like a volcanic crater with one side blown out, and it is surrounded by rocky pinnacles of the wildest forms, which appear, and for the most part are, totally inaccessible. It is certain that no one has succeeded in passing this serrated barrier at any point.*

The glacier of Talefre is pretty even on its surface, and is covered for a great part of the year with snow; its level, according to De Saussure, is 1334 toises, or about 8500 English feet above the sea. In the centre of the snowy basin is a very large exposed surface of rock, of a triangular form, covered with soil on its lower part, sufficient to maintain a good turf, enamelled

* The Couttets wished to pass to the glacier of Argentière behind the Aiguille Verte, but having gained the ridge, they were unable to descend.

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with the usual alpine flowers, during the few weeks of the year that it is entirely uncovered with snow. This spot is called the Jardin (or *Courtil* in patois), and is now a very frequent excursion from Chamouni. There is a spring of water near the lower part, and lying exposed, at a high angle towards the south, it is anything but cold in fine weather. Indeed I scarcely ever remember to have found the sun more piercing than at the Jardin. On three different occasions I have visited it, and on all under the most favourable circumstances, in 1832, in 1839, and in 1842.* The reflection of the heat from the snowy basin by which it is surrounded, and its comparative shelter from the wind, probably cause this intensity. On each visit I have found the scenery if possible more admirable than before. On the last occasion I climbed to the very summit of the triangular rock forming the Jardin, a task of more labour than it would appear to be, as it is both long and steep. The top is at a level of 9893 English feet above the sea (trigonometrically determined), and commands an admirable range of view. From thence I took a number of magnetic bearings for the plan of the glacier. The glacier du Talefre presents two medial moraines, marked on the map; one takes its origin from the Jardin itself, the other is derived from Les Droites, already mentioned. These become commingled during the precipitous descent of the ice, and reappear as one on the glacier de Léchaud.

From the Jardin it is not difficult to descend to the

* And also since (1854).

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glacier de Léchaud by the south margin of the glacier du Talefre. The passage of the last named glacier is, however, almost always wet, and the foot perpetually bursts through the frail superficial coating of ice formed in the night, and plunges ankle-deep into the snow-cold sludge beneath. The lateral moraine gained, it presents a steep and uneasy descent towards the glacier de Léchaud. At about two-thirds of the descent is a grassy shelf upon which some of the debris of the moraine have accumulated. One mass is of enormous size, and from its peculiar form is well seen from the glacier de Léchaud in all directions. It is a useful landmark, and is called La Pierre de Béranger, no doubt from a M. de Béranger who is frequently mentioned in M. Bourrit's narrative, though I am not acquainted with any particulars respecting him. The Pierre de Béranger is marked on the map; it is sometimes used as a shelter for the night by hunters; thence the glacier may be more easily gained by the rock than by the moraine, a byepath not generally known to the guides.

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CHAPTER VIII.

JOURNEY FROM CHAMOUNI TO VAL PELLINE, BY THE VAL DE BAGNES AND COL DE FENETRES.

Traces of Ancient Glaciers from Les Montets to the Tête Noire—Arrival at the Great St. Bernard—Find M. Studer—Return to Orsières—The Val de Bagnes—Chable—The Inhabitants Glacier of Getroz—The Débacle of 1818—Châlets of Torembec—Economy of Châlets, and Manners of the Inmates—Glacier of Chermontane—Col de Fenetres—View into Italy Valley of Ollomont—Goitres—Arrival at Val Pelline.

Before going to Chamouni in June 1842, I had visited my friend M. Studer, professor of geology at Berne. We then agreed that a plan, which had been vaguely discussed between us the year before—of visiting the neighbourhood of Monte Rosa, and the almost unexplored valleys to the westward—should, if possible, be accomplished in company that summer. M. Studer visited me on the 1st August, at the Montanvert, and we then fixed the 12th of that month for a *rendezvous* at the Convent of the Great St. Bernard, he, in the meanwhile, making an excursion into the Tarentaise, whilst I remained pursuing my survey of the Mer de Glace, and determining its motion. Accordingly, on the 11th, I left Chamouni, having engaged an active young man

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(not a professed guide) of the neighbourhood, named Victor Tairraz,* to accompany me on the expedition, and to carry my haversack and instruments. M. Studer and myself had already decided on taking one man a-piece as a personal attendant, and to secure guides from time to time, to assist in carrying the provisions,—which he was well aware would be requisite, from having in 1841 visited the valley of Erin, and seen the almost total destitution which there exists of the ordinary commodities of life.

I had proposed crossing the chain of Mont Blanc, by the glacier of Le Tour, to the valley of Orsières, a pass which has already been alluded to; but I was prevented, partly from the difficulties and endless formalities often made by the guides of Chamouni, when any unusual expedition is contemplated, with a view of enhancing their services—and partly from a trifling accident to my foot, which yet occasioned me some concern, with the prospect of a prolonged and difficult expedition before me. I therefore rode to Martigny by the Tête Noire, a route with which I was already pretty well acquainted, but which offered me new subjects of remark and speculation connected with the ancient extension of glaciers. I observed the distinct prolongation of the ancient moraine of the glacier d'Argentière towards the pass leading by Les Montets from the valley of Chamouni into that of Valorsine. This moraine seemed to me not less clear in its origin and details than that of the glacier des Bois at Tines; and the low ridge of rock separating the

* Now one of the regular guides of Chamouni (1854).

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two valleys is strongly marked by glacier action, which has also deposited a number of granite boulders on the summit of the pass. The whole valley of the Tête Noire shows, from time to time, proofs of having formerly been filled with moving ice, and between the cascade of La Barbarine and the little inn of Tête Noire, I observed the celebrated Valorsine puddingstone rock, which is exceedingly hard, beautifully fluted and polished, at a great height above the bed of the torrent.

I slept at Martigny, and next day proceeded in company with other travellers as far as Liddes, in a char, whence we walked to the convent, where I had the great satisfaction of finding that M. Studer had arrived only half an hour before from the southern side of the Alps, together with his tried and faithful attendant, Klaus, a peasant of the Oberland, who, for twenty summers, has followed the indefatigable Professor of Berne in his geological rambles, and has rendered himself a deserved favourite and friend, by his experience, hardihood, simplicity, and that peculiar patience and fertility in expedients which characterizes the best guides of German Switzerland, together with an honest warmth, and even playfulness, which is less commonly united with it.

Our greetings were hearty when we met around the hospitable fire, which, even in August, is the chiefest luxury in the domicile of the worthy fathers of the Great St. Bernard. The evening was partly spent in discussing our plans, to which the priests lent an interested ear. One of them, the Chanoine L'Eglise, almost

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volunteered to accompany us on a part of our journey, but unavoidable engagements in the convent prevented it; however, he kindly gave us letters, which proved of service.

The next morning, at eight o'clock, I found water to boil at 199.08 Fahrenheit, the convent barometer being at 576.1 millimetres, unusually high in this position. Accordingly, the fathers predicted favourable weather for our expedition.*

We walked leisurely down to Orsières by the same road as I had ascended the previous day, for we had decided upon commencing our journey by ascending the valley of Bagnes, which separates at St. Branchier, a little below Orsières, from the valley of Entremont leading to the Great St. Bernard. I was struck with the small interest of the Swiss side of the St. Bernard Pass. It was ten years, within a few days, since I had last visited it, but I well remembered the tedium of that interminable descent to Martigny. All the higher part is bare and wild, without much grandeur or variety,—of course I mean in comparison with other alpine passes.

At Orsières we introduced ourselves to M. Biselx, formerly prior of the convent, and now curé of Orsières, a man known in the scientific world by his zeal and acquirements, an intimate friend of M. de Charpentier, and partaking his views on glacier theories. Our in-

* I determined the geographical position of the Great St. Bernard, as I did that of Chamouni in 1832, and found it to be
Lat. 45° 50′ 16″ N. Long. 7° 4′ 45″ E. of Greenwich.

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troduction was easy, and the evening passed pleasantly in his society. Indeed, we had a marked proof both of his skill and experience; for learning that M. Studer's syphon barometer was injured by having taken air, and considering the interesting results which it might afford on our present excursion, he begged to be allowed to boil the mercury in the tube, a critical and disagreeable operation as every one knows, but which he most effectually accomplished on the spot with his own hands over a charcoal stove in the kitchen of the inn; he then bade us a hearty farewell.

At Orsières, we made a considerable provision of food for our journey, for we were immediately to leave the beaten track. A guide was engaged to go as far as Chable, the principal village of the Val de Bagnes, where M. Studer had already been the preceding year, and had made an acquaintance who might be useful in procuring us a person familiar with the higher parts of the valley, and with the Col de Fenêtres leading into Italy.

At length, all preliminaries being settled, we left Orsières, in a beautiful morning. The view towards the chain of Mont Blanc was particularly fine, as seen by the early sunlight. The landlord of the Hôtel des Alpes particularly pointed out to us a conspicuous granite peak, which he called Pointe d'Ornex, and which he assured us was known by no other name in these parts. This must, therefore, undoubtedly be the same as Van Buch referred to in his paper in the *Berlin Memoirs* on the distribution of erratic blocks, and to

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the neighbourhood of which he referred the origin of the Pierre à Bot and other masses of granite on the Jura range. The Mont Catogne, a conspicuous hill between Orsières and St. Branchier on the left, is composed partly of granite, but its eastern face, which is very steep, presents a vast triangular *revêtement* of limestone, which here, as elsewhere, rises against the primitive rock, which, as we have seen, bounds the Val Ferret in its whole extent. On the face of this limestone slope lies one of those vast masses of transported granite described by M. de Charpentier, under the name of *blocs perchés*, which afford so strong an evidence in favour of his theory of glacier extension. This vast mass may be distinctly seen, notwithstanding its distance and height, from Orsières, on a steep part of the rock, free from the trees which nearly surround it. Its position is exceedingly remarkable, for it seems impossible to conceive a block of that size deposited by the mere force of water at such a height above the bed of the valley.

Our party now amounted to five, of whom the three guides were all considerably laden, for, besides personal effects, and some instruments, we carried a provision of rice, bread, and meat, intended for three days. M. Studer's barometer was the only instrument for measuring heights which we could at the time depend upon, but I had a portable sympiesometer, by Adie, constructed on purpose for this journey, but whose indications required a special correction difficult to determine, and one of those very convenient Russian furnaces,

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made by Stevenson of Edinburgh, which proved an invaluable adjunct for melting snow, for making tea, and at the same time for ascertaining the temperature of boiling water by a thermometer, which I had adapted to it, reading from 185° to 213° Fahr., and on which a fiftieth of a degree was capable of estimation. This is the only instrument which I have found capable of resisting sufficiently the influence of wind and cold to produce boiling water even from snow, in almost any situation, and it replaced the barometer usefully, on several occasions, as will be seen.* The appearance of our party was sufficiently remarkable to attract the attention of the passers by, of whom, at this early hour, there were a number on their way, to spend the day at Orsières, as it happened to be a great festival in this and the neighbouring valleys,—the eve of the Assumption of the Virgin. The day, as I have said, was splendid, and promised to be very warm; but our course, as far as Chable, lay almost entirely on the shady side of the valley of Bagnes, which we entered by turning abruptly to our right, before entering the village of St. Branchier, an hour's walk below Orsières.

The path, which was scarcely traced on the left bank of the rapid and impetuous Dranse, passed through woods and meadows, and the whole scene was refresh-

* An account of the method used for calculating heights from the temperature of boiling water will be found in the *Edinburgh Transactions*, vol. xv., part 3. I have found that the temperature of the boiling point falls 1° Fahr. for 550 feet of ascent, *uniformly* for all heights, subject to the usual barometrical correction for the temperature of the air.

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ing and peaceful in the highest degree, and seemed to augur success to an excursion so happily commenced. Chable is a considerable village, very pleasantly situated in a tolerably open space, into which the valley enlarges itself, near the foot of the Pierre à Voie, a conspicuous summit, which separates this valley from that of the Rhone, and not far from which a path leads from Chable to Riddes, on the Simplon road. The neighbourhood is very fertile, covered with fruit trees and meadows, and studded with several villages; at this season it has a peculiarly cheerful and thriving aspect. As we approached the village (having joined the great road) we were struck by the appearance of the peasantry, and by the great numbers who had met together on occasion of the festival. So numerous were they, that we were not surprised to learn, that within the very small range of the Val de Bagnes, which is permanently inhabited, there is a population of 9000 souls. All the avenues to the church were crowded with well dressed, respectable looking men, the women being chiefly within the building. Our arrival and accoutrements excited some surprise, but we were allowed to pass unmolested by ill-bred curiosity, to one of the principal houses of the place, belonging to M. Gard, to whom M. Studer had been recommended on his former visit, and who, though a person of some consequence in the place, condescends, as is not unusual in similar circumstances in many countries, to make his house one of public entertainment, and the resort of the better class of peasantry, who, when the service

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was over, came and called for their *chopine* of wine, as they would have done in any common inn.

It was vain to think of proceeding any farther in a hurry. The demeanour of the people was intelligent, independent, and almost sarcastic. A guide was our first requisition; and it was evident that though there would be no difficulty in procuring one who was acquainted with the pass into the Pays d'Aoste, his accompanying us would be considered rather as a favour, and must be upon his own terms. These, however, were in due time adjusted with the usual success and conciliation with which M. Studer always contrived to effect these negotiations, which he kindly undertook to superintend; and after a considerable delay, which had not, however, the effect of enabling us to escape the hottest hours of a very warm day, we set forth under the guidance of Jean Pierre Feilay, who had been recommended by M. Gard, and who presented a fair specimen of the manly bearing and somewhat haughty independence which I have mentioned as characteristic of the inhabitants of this valley. After half an hour's walk from Chable, we reached Champsec, a small hamlet, in a great measure destroyed by the catastrophe of the inundation of 1818. Here our guide lived; and as he had some domestic arrangements to complete, we lost the greater part of another hour in waiting for him. At last all was complete, and we were fairly in marching order. A little way beyond, we gained the northern side of the Dranse; and having passed the village of Lourtier, the last in the valley, the path

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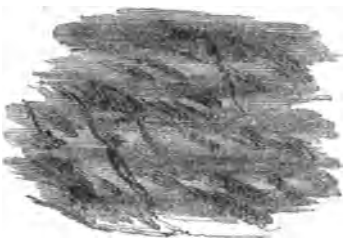
ascends rapidly. The river is discharged through a sort of chasm, which shows evident marks of the devastating force of the torrent on the occasion alluded to. The character of the scenery becomes more grand, the walnut trees and irrigation disappear, and we are once more in the region of pines and savage rocks. We remarked here a pretty illustration of the friction of



Glacier and Water Marks on Limestone.

glaciers as distinguished from that of water. The sides of one of the ravines through which the stream struggles is distinctly marked on its bold limestone surface by the long grooves which have been considered as peculiarly characteristic of the abrasion of glaciers. Though the descent is very steep, and the wall of rock almost vertical, these chiselled and polished grooves are worn out in a nearly horizontal, slightly declining direction, and are *continuous* for many yards or fathoms. Superimposed upon these, on the very same surface, are the marks of wear resulting from the action of floods, probably charged with great masses of debris. The water-marks are rough and contused, quite in contrast with

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the smooth prolongation of the other. They also slope downwards at an angle similar to that of the river bed, whilst, as has been said, the others are nearly horizontal.

A succession of basins and rocky chasms diversifies the length of the valley during several hours. I have seldom felt heat more oppressive than during the first part of this walk, while toiling up the steeps above Lourtier. Having, for several weeks previously, been almost constantly on the ice, and at a height of 6000 to 8000 feet above the sea, the contrast of temperature was, I suppose, more strongly felt. The chasms presented wild cascades, containing the whole body of water in the Dranse; but the picturesque effect was certainly very much injured by the dingy and opaque appearance of the glacier stream, which rendered the sheets dull and lustreless, instead of sparkling and transparent. The valley above Chable is very confined, and almost untenanted; there are but a few châlets inhabited, during a small part of the summer, higher than Lourtier. Hence the Val de Bagnes, which is very long, acquires a wilder and more lonely appearance than many valleys more remote, and more difficult of access. Many cottages which once existed are now dismantled, and it was near one of these that we stopped to take our mid-day meal beside a brook; a little higher the defile became suddenly narrow, and presented a bold and picturesque outline. The Mont Pleureur stood before us on the left, from which descends the well-known glacier of Gétroz. Still more on the left is the little frequented

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pass called the Col d'Orsera, leading to the valley of Hérémence, which had been traversed by M. Studer in 1841. The Dranse emerges from a dark defile, impassable on the left, and only to be traversed on the right by taking a high line above its level; from thence the water, swelled to its fullest in the month of August by the contributions of the various glaciers which we were soon to approach, emerged, sometimes in thundering cascades, sometimes pausing in still deep pools as it passes under a fine and romantic stone arched bridge, called Pont de Mauvoisin, by which we were to pass from the right bank of the river, which, since Champsec, we had continually followed, to its left bank, on which alone we could pass the defile. The bridge here, like almost every other in the valley, was carried away by the debâcle of 1818, and the present lofty stone one has been since built, with a solidity which is rarely met with in such sequestered spots, where but a very few persons pass during the entire year. A few huts in front—the last built with any degree of solidity—concluded the picture.

The bridge passed, we slowly gained the elevation of rock on the other side. A carefully made path continues for some way farther, and traverses one of those steep inclines of shingle annually swept by avalanches, which require the track to be made afresh every year. This path continues on the left bank of the Dranse at a great height above it, affording at the same time a striking view of the Mont Pleureur, and the glacier which has been the principal cause of so much devastation.

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I felt some disappointment in viewing the glacier de Gétroz, of which I had heard so much, and of which the disastrous effects had been so great. I had expected to see one as vast and beautiful as the glacier of La Brenva, for example, where, falling into the Allée Blanche, it forms a natural bridge above the torrent, or that of Miage, whose stupendous moraine once formed a lake, as the ice of Gétroz did. Instead of this, I found the defile narrow and confined, and though savage, scarcely picturesque. The proper glacier of Gétroz is situated at a great height amidst the defiles of the Mont Pleureur, so that its extent cannot be appreciated, or its beauty admired, even from the elevation of the path opposite. The real source of the mischief is a secondary, and very uninteresting looking glacier, which, in its present diminished form, scarcely attracts attention in the depth of the valley, and resembles the masses of unmelted snow which so often choke elevated defiles during a great part of the summer. It is in reality composed of the fallen fragments of the true glacier, projected in the form of avalanches over a cliff of enormous height, where the true glacier terminates, whose mass, as it advances, is broken off, and falls headlong into the abyss. The *glacier remanié* which results is soiled and imperfectly consolidated, and still forms a partial bar to the river Dranse. It must continue to do so, as long as the stream has no independent outlet, for the defile is so narrow, and the falling masses of the glacier so extensive, that the outlet must inevitably be choked in winter and spring when the Dranse (which owes its origin almost entirely

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to the glaciers still higher up the valley) has too feeble a current to keep its way clear.

The story of the debâcle of the Val de Bagnes in 1818, is too well known to require to be detailed here, and I have no new facts to add. It is sufficient to call to mind, that twice in the sixteenth century a similar mishap occurred, and indeed it is difficult to conceive why it should not have been much oftener repeated. The year 1818 had been, as we have seen, remarkable for the extension which most of the glaciers in Switzerland had experienced after a series of cold winters, and in this year the ice beneath the glacier of Gétroz accumulated so much, as to have formed, by the stoppage of the Dranse a lake no less than half a league long, 700 feet wide, and at one part, 200 feet deep. The impending danger was perceived,—the bursting of the lake with the return of spring was a certainty. M. Venetz, the intrepid engineer of the Valais, and the founder of the modern Geological Theory of Glaciers, proposed to avert it by cutting a canal through the ice, which should gradually drain the lake. Between the 10th of May and the 13th of June this was effected, and it was trusted that the channel would be sufficiently deepened to let the water gradually escape. But water already at 32° has only a feeble action in eroding ice, and the result was, that the cascade tumbling over the icy barrier worked back upon it so fast, that the gallery or canal, which had been originally 600 feet long, was destroyed, and fell away in fragments. Nor was this all, the cascade working on the soil beneath had loosened it so as to

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detach the remaining ice from the mountain, and thus precipitated the catastrophe. A deluge of 500 millions of cubic feet of water were let loose in the space of half an hour, to sweep through a tortuous valley full of defiles, —literally with the besom of destruction. A flood five times greater than that of the Rhine at Basle filled the bed of a mountain torrent. It was an awful, but a grand lesson for the geologist. The power of water was exerted on a scale such as Hutton and Playfair would have desired to see, could it have been exerted without the destruction of life and property. Bridges yielded; that at Chable dammed back the torrent upon the village, but happily gave way just as the houses seemed doomed to ruin. In this short space of its course (from Gétroz to Chable), the fall is no less than 2800 feet. Its acquired velocity was therefore enormous,—at the commencement of its course 33 feet in a second. Its power to *overthrow* buildings, and to *carry with it* trees, hay-stacks, barns, and gravel, cannot surprise us. But its transporting force upon blocks has probably been over-rated.* Enormous masses were certainly *moved*, especially in the neighbourhood of Martigny, as described by Captain Hall and Mr. Lyell, who were both on the spot soon after the event. But there is no kind of evidence that these granite masses were brought down from the higher valleys by the torrent. On the contrary, I believe that there is no question but that they

* On the debâcle of Bagnes, see Bibliothéque Universelle, 1818; Edin. Phil. Journal, vol. i.; Lyell's Geology, 1st edit. vol. i.; Captain Halls "Patchwork," vol. i.

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lay (having been transported by ancient glaciers, or in some other mode) within a very short distance of their present positions, and that some of them were merely rolled over a few times by the force of the current. I apprehend that the debâcle of Gétroz gives no countenance whatever to the opinion, that blocks of 20 or 30 feet of linear dimensions can be transported to any distance even by such stupendous currents.

When we passed the glacier of Gétroz, there were workmen (for whose use chiefly, no doubt, this road is kept in repair) employed in dividing the ice into blocks, by the ingenious process of Venetz, in order to be carried off by the stream, and prevent future accumulations. The process consists in turning streamlets of water (not ice cold) by means of wooden canals upon the ice, so as to saw it through in the required direction, which is effected with rapidity and certainty. This operation is annually repeated, requiring the combined labour of several men for many weeks each summer. The expense is borne by the canton. There is but one way of permanently avoiding the risk in future, namely, by constructing a tunnel, or cutting one through the rock, by which the torrent may have a certain egress, independent of the state of the glacier; but this has been considered as too expensive and difficult an operation under the circumstances.

Our way now lay up the bed of the former so formidable lake. The bottom of the valley is flat and monotonous, the river wandering from side to side, amidst rolled pebbles. Descending to its level, we re-

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crossed to the eastern bank. Our walk from Chable had cost us nearly four hours, and an hour and a half later we reached our humble resting-place for the night, the châlet of Torembec, 5300 feet above the sea.

The accommodation offered in the upland and unfrequented châlets is everywhere nearly the same, and may therefore be worth describing for once. There are usually two buildings, quite distinct, the day and the night apartment. The reader must not, however, suppose that these correspond in the remotest degree either in appearance or in furnishing to the correlative establishments of a drawing-room and a bed-room; the first contains neither tables nor chairs, the latter neither mattress nor pillow. The morning room is more properly a manufactory of cheese and butter than a place of ordinary accommodation. The fire is kept up for the purpose of heating the milk, which is done in copper cauldrons, whose size, and weight, and bright polish contrast strongly with the want of every ordinary convenience of life. A number of copper and other vessels for holding milk and raising cream occupy most of the spare room in the apartment; the floor is of earth and uneven, but, except in Piedmont, not usually dirty. The fire-place is a hole in the ground, the fuel is juniper, or scraps of larch wood where these can be had; and a sort of movable wooden crane, from which the copper pot is hung, is one of the most artificial accommodations. There is no chimney, and therefore the fire is usually made near the door; nor are there windows of any description. For light, they use a little fat,

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burning with a wick in a small vessel, but often merely a bit of the more resinous pine wood, which they keep on purpose. There is no such thing as a table, unless the top of a chance barrel be admitted as the representative of one; nor are there any chairs, though the *one-legged* milking-stool, which affords an inconvenient repose to a weary traveller, is an indulgence which he probably owes solely to its indispensability in the great and overweening object in which all the uses and habits of a châlet centre—the keeping and feeding of cows, and the procuring and manufacture of milk. Morning, noon, and night, the inhabitants think but of milk; it is their first, last, and only care; they eat exclusively preparations of it; their only companions are the cattle which yield it; money can procure for them *here* no luxuries; they count their wealth by cheeses.

The absolute want of culinary utensils is surprising and embarrassing. The only pot is sometimes that employed for heating milk, and of *copper;* at other times there is also an iron one; but, except certain wooden skimming-spoons, nearly square, and five or six inches wide in the mouth, there is often no other kind or description of dish, vessel, platter, spoon, or ladle. Where the civilization is a little greater (as at Torembec) there are a few *écueils*, or wooden bowls. Of course these deficiencies only created amusement to us, and the rice we had brought was boiled with milk and salt (which is kept for the cattle) in the only iron pot, and made a most substantial and not unpalatable mess for five hungry men, with a surprisingly small consumption of

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our stock. The evening meal being concluded, we betook ourselves to early rest. The sleeping apartment, I have said, is usually, as in this case, a separate hut, without window, fire, or chimney, built of loose stones, and with a door about three feet high, the floor being covered with grass more or less dry. On this we arranged ourselves in *parallel order*, covering ourselves with a sufficiency of the hay. It might have been hoped that here we should have escaped the torments of a bad bed—I mean the vermin; but we had the inconveniences of a hay-loft without its inestimable advantage—cleanliness; and in the course of the night I was forced to rise, and, stumbling over the bodies of four or five of my insensible companions, seek relief for a while in the open air, which was exceedingly mild.

We were astir by five. But it is impossible, generally speaking, to depart in a hurry from a châlet, any more than from a fashionable hotel. It was half-past six before we had breakfasted, and made up our packages; and having left our hosts satisfied by a moderate gratuity, our caravan was once more under way with the glaciers in our front. Before leaving the subject of châlets, I may observe that the character of the inhabitants is not undeserving of notice. I have always received, both in Switzerland and Savoy, a gentle, and kind, and disinterestedly hospitable reception in the châlets, on the very bounds of civilization, where a night's lodging, however rude, is an inestimable boon to a traveller. These simple people differ very much (it has struck me) from the other inhabitants of the

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same valleys—their own relatives, who, living in villages during the busy trafficking season of summer, have more worldly ways, more excitement, wider interests, and greater selfishness. The true *Pâtre* of the Alps is one of the simplest, and, perhaps, one of the most honest and trustworthy of human beings. I have often met with touches of character amongst them which have affected me, as I may elsewhere notice; but, generally, there is an indescribable unity and monotony of idea which fills the minds of these men, who live during all the finest and stirring part of the year in the fastnesses of their sublimest mountains, seeing scarcely any strange faces, and but few familiar ones, and these always the same; living on friendly terms with their dumb herds, so accustomed to privation as to dream of no luxury, and utterly careless of the fate of empires, or the change of dynasties. Instead of the busy curiosity about a traveller's motives and objects, in undertaking strange journeys, which is more experienced in villages the more remote they be, these simple shepherds never evince surprise, and scarcely seem to have curiosity to gratify. Yet far are they from brutish or uncouth; they show a natural shyness of intermeddling with the concerns of strangers, and a respect for their character testified by their unofficious care in providing and arranging what conveniences they can produce. Their hospitality is neither that of ostentation nor of necessity. They give readily what they have, and do not encumber you with apologies for what they have not. Every traveller will see in this description,

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strong opposition to the Swiss character as usually displayed; my remarks are confined to my experience in the higher *châlets* of the Alps. Of course, I do not mean to state that exceptions are not to be met with.

The same *ménage* exists merely on a larger scale, where the *Alp* or pasture ground is greater. In many an extensive range of cow-houses is attached to the enclosure of the châlets. In some places, the cows are brought in to be milked; in others, this operation is more picturesquely performed by ranging the cows—(*Rans des Vaches*—whence the popular name of some Swiss airs)—on green sward terraces on a hillside, where they may be seen to the number of some hundreds, tied each to a little stake, whilst the shepherds busy themselves amongst them with their milk-pails and one-legged stools. But to return to the Val de Bagnes.

At half-past six, we left Torembec, and ascended the remaining part of the valley, which opened itself a little higher (the now small stream of the Dranse being again crossed to its western or left bank) into a scene of greater majesty than it had yet presented. A corner was turned, the valley trending more to the south-east, and several glaciers hitherto concealed came into view. The recollection of the heat of yesterday made these a welcome sight, and I looked forward with pleasure to setting foot on ice again.

The first glacier visible on the right hand descended in 1821, as our guide Feilay informed us, so far into the valley as to approach the torrent. It has now retreated to a great height on the mountain side.

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Again, on the opposite or eastern bank a vast glacier descends from the lofty chain which separates the Val de Bagnes from that of Hérémence. It is called the glacier de la Brēna, and is probably that marked "les 28" in Wörl's map. It now terminates on the bank of debris, which it has carried down on the farther side of the torrent, but we were assured that in 1822 it had extended so far as to cross the torrent, which made its way under it, and to rise to a great height on the western side. Indeed, this was matter of ocular evidence, for our path touched the extremity of the enormous frontal moraine which it had thrown up,—a mound of rocky fragments, from whose top we could clearly survey the vast area, of many acres in extent, which the glacier has uncovered during the last twenty years, strewed with fragments, and doomed to sterility. The material of the moraine is a true granite, the first we had met with in this valley, for below the rock is a kind of gneiss. According to our guide, the ice then presented a front seventy feet high. A little farther in advance, an extensive glacier, named Glacier de Durand, descended from the Mont Combin on our right, which it was impossible to avoid; we therefore prepared to cross it, which we did without difficulty. It descends quite into the valley, and crosses the stream as the glacier de la Brēna had done, leaving a free passage beneath. The mere crossing of a valley by a glacier, if it be of any moderate breadth, is not of itself sufficient to produce a catastrophe like that of Gétroz. Here is one example; the glacier of La Brenva in the Allée Blanche is another,

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and that of Allalein in the valley of Saas. It is probably the circumstance that the dam was formed by the *éboulement* of the glacier of Getroz, and not by the glacier itself, which occasions its particular danger. A channel once formed under a glacier is kept continually open, as the glacier advances gradually onwards, but the falling in of ice may produce an abrupt stoppage.

The glacier of Durand presents an even and clean terminal slope, of a convex form, with few fissures, and shows the system of veins which I have elsewhere described as proper to that form.

This glacier crossed, we arrived at the upper châlets of Chermontane, at the foot of the glacier of the same name, which fills the entire head of the Val de Bagnes, and nearly touches the glacier de Durand, (see the map, page 1). From these châlets (which are still on the western side of the valley, and at the foot of a hill called Mont Avril) there is a very fine view; the glacier of Chermontane is a magnificent sea of ice, nearly or quite unexplored. It appears to have three great tributaries—one descending from behind the mountain called Ottemma, and where there is every appearance of there being a col or pass; we thought that we clearly saw the summit level. In this direction, it is probable that a passage might be effected to the glacier of Lenaret in the Val d'Hérémence, or to that of Arolla, at the head of the Vallée d'Erin; but the descent on the other side would be more difficult. The second branch passes between the Trumma de Bouc and the Mont Gelé, derived partly from a very lofty

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snow-capped peak, and partly from a short branch immediately behind the Mont Gelé, which can be of no great extent, since from its direction, it must speedily reach the Val Pelline; and, indeed, we were informed that the shortest way to the village of Biona was in that direction, but our guide had never passed there. The third great arm of the glacier stretches up to the Col de Fenêtres, between the summit of Mont Gelé and Mont Avril, by which we were to pass.* The glacier of Chermontane terminates a little below the châlet of that name. On its farther side is a pretty pasturage, called Chamrion, *(Champ Rond)* where there are two small lakes—one formed in a hollow of the hill, the other between the slope of the hill and the ice of the glacier, somewhat like the lake Mörill on the glacier of Aletsch.

I have already said that the upper part of the Val de Bagnes is little visited. I find no notice of it in the writings of De Saussure; but Bourrit, in his lively work on the glaciers of Savoy, describes having reached the châlet of Chermontane, where he slept two nights, and visited the neighbouring glacier, of which he gives a somewhat pompous account, and a most exaggerated drawing of the lake; but he did not attain any summit or col; indeed, I have not met with a description of the Col des Fenêtres, from personal observation in any work. It was by this pass that Calvin

* The topography of this region has recently been fully explored by MM. G. Studer and Ulrich, who succeeded in passing from Hérémence to Bagnes (1854).

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fled in 1541 from persecution in Aosta, where he had been established for five years.* Though M. Bourrit speaks much of the discoveries which he made during his visit to Chermontane, they appear to amount merely to this—that he ascertained the existence of a great glacier, but neither its extent, its practicability, nor the connections of the ramified valleys which meet near its head. Formerly, it appears that this col, like many others in the higher Alps, was easier passed than at present, and was even a common route of commerce. At that time, it is stated,† the glacier of Durand did not extend so low as to require to be crossed, but was avoided. So small is the communication now, that there is not even a station of custom-house officers on the pass, though there is at Val Pelline.

We did not stop at Chermontane, or even go to the châlets, but, keeping on our way at a higher level, along the slope of Mont Avril, we gradually ascended towards the Col de Fenêtres, always on turf, and without any difficulty. The ascent was tedious and we skirted the glacier without going upon it, for the greater part of the way. The glacier de Fenêtres, is but little inclined or crevassed; in its higher part we traversed a portion of it without difficulty, so as to gain the col more quickly. We reached the summit in four hours of easy walking from Torembec. For its height—which appears to be 9213 English feet, by M.

* Compare Bourrit, II. 76, and Baruffi Viaggio in Piemonte; Lettera 27ma, p. 19.

† Godefroy, *Notice sur les Glaciers*, p. 63.

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Studer's observations—this must be considered as an easy pass, presenting, in good weather, not a shadow of danger.

The view towards Italy is wonderfully striking. The mountains beyond Aosta, and the glaciers of the Ruitor, are spread out in the distance, and beneath we have the exceedingly deep valley of Ollomont, communicating with the Val Pelline, which is itself a tributary of the Val d'Aoste. It is enclosed by ridges of the most fantastic and savage grandeur, which descend from the mountains on either side of the col on which we stood,—on the north-east, from the Mont Combin, rising to a height of 14,200 English feet; on the south-east, from the Mont Gelé, which is 11,100 feet high, and almost too steep to bear snow, presenting a perfect ridge of pyramidal aiguilles stretching towards Val Pelline. The side of Mont Gelé towards the col presents an adhering snowy coat so steep, that, seen in front, it appears almost vertical; measured laterally with a clinometer, its angle was found to be 55°; this appeared to be loose snow. Our course to Val Pelline required us to skirt the foot of the peaky ridge just described; the descent was unusually rapid, and without particular difficulty. We passed a small lake partly bordered with snow, and soon after gained the pastures. Here we made a hearty meal by a brook, which exhausted a good part of our available provisions, and we thence dismissed our guide, who had plenty of time to recross the mountain by daylight. It was a considerable way before we reached any châlet, but when we did so, we

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caught a charming view of the bottom of the valley of Ollomont, which had hitherto been mostly concealed, covered with exquisite verdure, studded with houses, and traversed by lively streams, all seen as on a map, for our elevation was still 2000, if not 3000 feet above it. Beyond, the mountains near St. Bernard were apparent;—below, the village of Vaux which we mistook for Ollomont. There we found copper works abandoned; they appear to have been very extensive and complete; the ore is a sulphuret, in the (metamorphic?) gneiss of which the whole of this district is composed. There are several other villages, and Ollomont itself, composed of but a few scattered houses, distinguished by a church, is pleasingly situated. But here, as at Aoste, the enjoyment of natural beauty is rendered impossible by the loathsome deformity of the inhabitants; we were really shocked to find that none of the villages through which we passed seemed to contain one reasonable human being;—goîtres and cretinism appeared universal and inseparable. Repeatedly I tried to obtain an answer to a simple question from the most rational looking of the inhabitants—but in vain. This astonished and shocked us, for we were still at a height of 4000 English feet above the sea, where these maladies commonly disappear; and we looked forward with despair to the prospect of obtaining a guide for the difficult and unknown country which we were next to traverse, from amongst such a population. But in this, as in very many similar cases, first appearances are not to be interpreted to the letter. It was still the fête of

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Notre Dame du mi-Août, and the effective population had mostly gone down to Val Pelline, the chief place of the district, and others perhaps were with their herds in the mountains.

The scenery continued more and more engaging. In the course of four hours' walk we had passed from ice and eternal snow to the charms of Italian scenery and climate, with more than Italian verdure. We looked anxiously about for the village of Val Pelline, which we expected to have seen from a distance,—we feared that our maps had deceived us, and that we had yet a considerable walk before us, when suddenly, on turning a corner, we found ourselves in the valley of Val Pelline; the church, with a spire of the Italian taste, and a few scattered houses, mantled with vines and peeping out amidst walnut trees of exquisite beauty, proclaimed the little capital of the district. In descending we noticed large fragments of true syenitic granite, which appeared to have their origin at no great distance, which we hoped that our next day's walk would reveal; in the meantime we entered the village.

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CHAPTER IX.

FROM VAL PELLINE TO EVOLENA BY THE COL DE COLLON.

Ascent of the Val Pelline or Biona—Geology—Syenites—Châlets of Prarayon—Head of the valley—Ascent of the Col de Collon—Remains of travellers lost in a tourmente—Glacier D'Arolla—Its structural bands—Magnificent view of Mont Collon—Opportune meeting with Pralong—History of the victims—Arrival at Evolena.

"C'est le domaine des glaces et des neiges, le palais de l'hiver, le royaume de la mort."—A. Dumas.

The village or hamlet of Val Pelline offered little prospect of comfortable accommodation, but we recollected a letter with which M. Biselx had provided us at Orsières, addressed to a proprietor and householder of the place, by whom we were received in a manner which I am sure that neither M. Studer nor myself will ever forget. The unexpected appearance of travellers by so unfrequented a pass, and accompanied only by strangers, (for it will be recollected that we had sent back our guide to Bagnes) produced a momentary hesitation. The wife of the gentleman to whom we were recommended had not returned from church, and an awkward pause took place at the door of the house, which was locked, whilst our arrival

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excited some curiosity amongst the loitering groups around. At length the lady came, and hearing our story and recommendation, instantly set about every arrangement which true hospitality could devise to ensure our comfort whilst we remained, and to speed our journey when we departed. The afternoon was not far advanced, and we spent it in repose,—in a short stroll through the beautiful meadows surrounding the village,—and in conversing with our host and his sons, well educated and sensible boys, whilst our excellent hostess busied herself in preparing supper and in arranging our apartment, which was the best the house afforded. Meanwhile we made inquiry, not without anxiety, as to the possibility of finding a trusty and skilful guide who should conduct us across a glacier-pass which we understood to connect the head of the valley of Val Pelline, which is in Piedmont, with the Vallée d'Erin in the Vallais. This had always appeared the most doubtful step in our expedition. Though we had reason to believe that such a pass existed, we had no information of any traveller who had actually passed it, and we had been led to think that though guides might be found on the Swiss side, it would be much more difficult to procure them in Italy. The specimen we had seen of the natives of Ollomont increased our doubts; but the very circumstance of the fête, which had drawn so many to Val Pelline, gave us the greater choice of guides, and our host kindly aided us in the selection, and by his authority and consequence in the place, procured us a most satisfactory guarantee for the capacity and fidelity of any one who should

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accompany us. Amongst the visitors at Val Pelline that day, was a tall, athletic, and handsome man, below middle age, who passed for being the strongest man of the whole valley, and whose usual residence was some leagues higher up. With him our arrangement was soon made; he promised to remain all night, and to accompany us next day to the head of the valley of Biona (as the higher part of the Val Pelline is called,) whence starting early the following morning, the glaciers might be crossed to Erin. He assured us that he was perfectly acquainted with the pass, which he called the *Col de Collon.*

The village of Val Pelline is near the opening of the valley of the same name, and only from two to three hours' walk from the Cité d'Aoste. It possesses the Italian character of scenery and products, although 3040 English feet above the sea. The morning of our departure proved the prelude to a very hot day. We were tempted to rest longer than usual in our comfortable quarters, and as we had but a short journey before us we were in no hurry to depart. Madame A—— had anticipated all our wants. She had even prevented our servants from attempting to procure any of the necessaries which we wanted for our arduous journey, by insisting on providing them, much more effectually of course, from her own stores. The cordiality and genuine kindness of all her arrangements left us no room to offer any return but our truly heartfelt thanks for her generosity, and we quitted this worthy family with regret, being accompanied by one of the sons for a mile or two on our way.

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The valley was always narrow, but at Oyace, a little way above Val Pelline, it seems too close, and the village of that name is planted upon a rocky barrier which crosses the ravine, and which we found to be composed of true syenite, the same as M. Studer first noticed in boulders the day before, when descending upon Val Pelline. There appear to be from point to point amongst these wild hills, outbreaks of syenitic rocks which have more or less metamorphosed the neighbouring sedimentary deposits, and have confounded all mineralogical characters in the result of this supervening action. Such at least was the opinion of my learned companion, whose long and close attention to the excessively intricate phenomena of Alpine geology entitles it to the greatest weight; and to which any observations which I had an opportuuity of making in his company induce me entirely to subscribe. It is well known that M. Sismonda, the intelligent geologist of Turin, has endeavoured to separate the rocks of this part of the Alps into primitive and metamorphic, the one of which he has coloured red, and the other blue. So far as we could observe, this separation seems indistinct and inconclusive; and with the single exception of the true unstratified syenites,—such as those of the glacier of La Brēna in the Val de Bagnes, and that of Oyace,—the felspathose rocks seem to admit of no subdivision, but must be classed under the common denomination of gneiss, whether primitive or metamorphic.

The boulders already mentioned, and others which occur from time to time in the valley, appear to be all

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derived from the neighbouring mountains; and it is exceedingly remarkable, and quite in contrast to the appearances in the Val de Bagnes, that we found few or no striated and polished rocks, nor great masses of transported materials.

Between the villages of Oyace and Biona, we visited a vein of limestone, interstratified with the felspathose rocks in a direction parallel to the length of the valley, and re-appearing at intervals up even to its very highest part, where, as here, it is burnt for lime. Very near this, copper is found in the same rock as at Ollomont.

The village of Biona is the last of any size in the valley,—the last, I think, which has a church. The valley takes henceforth the same name, Biona. We halted here, and made a hearty meal in the open air upon fresh eggs and good Aostan wine. We then resumed our march, as the day became cooler, and the scenery, at the same time, still more picturesque and interesting. An excellent foot or mule path leads all the way up the valley, a convenience which the traveller owes to the Jesuits of Aoste, who have extensive property in the higher pastures of Biona; and it was at the châlet belonging to them that we proposed passing the night. The village of Biona is 5315 feet above the sea, by M. Studer's observation. Farther on, the larch trees descend into the valley, and the river passes through some picturesque defiles. The views looking back were very pleasing, and in front at the head of the valley, rose a lofty chain of moun-

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tains (a mere appendage, however, to the great chain) separating the valley of Biona from the Val Tournanche; over which we afterwards learned that a passage may be effected, though not without difficulty.

At length we reached the châlets of Prarayon, which belong to the Jesuits of Aoste, and are marked by a lofty crucifix in front. They are pleasingly situated in a green meadow near the head of the valley, and about six hours' walk from Val Pelline. There was no one visible, and it was some time before we obtained admission into the smaller and humbler building, the larger one being locked up. Whilst supper was preparing, I walked up alone to the head of the valley, which I was anxious to explore, for our guide informed us, that our next day's journey did not lie in that direction, but that we should have to return upon our steps a little way, and then turn sharply to the northward. It was an hour's walk to the commencement of the glacier, which fills the top of the valley, and which descends directly from the great chain. Having gained an eminence on the south-east side of the valley which commanded the glacier, I saw that the ascent of it must be in some places very steep, though I should think, not wholly impracticable. I recognised the limestone which we had found farther down the valley. Returning to the châlets, I found our evening meal prepared; and I observed the temperature of boiling water to be 201°.58, whilst M. Studer's barometer stood at 608.3 millimetres. The height above the sea is 6588 feet. The general direction of the Val Pelline is N. 60° E.,

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(true,) but for the upper two leagues N. 75° E., as far as the foot of the glacier, after which its course is N. 5° W.

We passed a comfortable night in a clean hay-loft, and slept longer than we intended, for we were not ready to start until 6 A.M. The morning was very favourable. Our guide, "l'homme fort de Biona," as he was called, or "*l'habit rouge*," the *soubriquet* which we had given him, from the curious practice of wearing scarlet cloth coats, which is common in the Pays d'Aoste—gave us at first no small concern. He was in low spirits last evening, and in no hurry to start to-day, and apparently not averse to draw unfavourable presages of the weather. We began to fear that he had undertaken more than he could perform, and that the way was perhaps known to him only by report. But our doubts gradually vanished. He took to the hill with that instinctive confidence which showed that he understood his business, and the farther we advanced, the more readily did he go on, and became more communicative. We afterwards found that he had been really unwell from the results of a drunken fit, from which he had not escaped when we first engaged him, and also that some doubt whether we should be able to follow him over the glacier and rocks, and a fear that he might be brought into trouble through our means, had probably oppressed him. We found him gentle, docile, robust, and trustworthy. During a part of this day's journey, he carried not only all our provisions, but no light share of the contents of Klaus's

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hotte or basket. His name was Biona, as well as that of his native place.

As we had been told the night before, we returned a little way upon our steps; then, following a water-course used for irrigation, we turned sharply to the right. All our maps were here at fault. That of Wörl especially, the most detailed, presents no kind of resemblance to the outlines even of the great chain, and the passage must have been put down at random. The pass is through the first lateral valley of the Val Biona below its head. We there find a deep gorge, completely glacier-bound at its upper end; but from the nature of the rocks, it admits of an easier ascent than the glacier at the top of the Val Biona. We passed some wretched shepherd's huts; and following an impetuous stream, we came to the foot of a glacier descending on our left, which has blockaded the valley with its prodigious moraine, and left a swampy flat above. This passed, we kept to our right hand, having in front of us another great glacier, which descends from the Col de Collon, and more to the left, a great and steep glacier, which appears to descend from the group of mountains connected with the origin of the glacier of Chermontane. The direction of the valley we ascended was at first N. 20° W. (true), and when we came in sight of the glacier which we were to follow, it turned sharply to N. 25° E. Pursuing a very steep and laborious ascent over rocks (without, however, any danger), we reached the glacier, where it was much more level than in its lower part, and ob-

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tained a distant view of the col. The ice was not much fissured, and we proceeded at ease—only we came at length to where it was covered with perpetual snow, and there we required to proceed with caution. We left upon our right hand, the mass of mountains which separate this pass from the head of Val Pelline, and on our left new and hitherto unseen chains began to display themselves, and rocks rising above the col or pass, which we were surprised to find marked by a very small iron cross, shewing that it is well known to the country people, although unfrequented by travellers. The only traveller whom I am aware of as having passed here is M. Godefroy, the author of an essay on glaciers,* already quoted. We now also learned the secret of our friend "l'habit rouge," being so well acquainted with this obscure route, for he admitted that he had frequently passed it with bands of smugglers, who avail themselves of all the less frequented passes for introducing the articles of free commerce in Switzerland into Piedmont. We reached the col in three hours from the châlet, which was sooner than we expected; and as it was only nine o'clock, and a beautiful morning, we sat for a long time on the rocks on the west side of the col, and enjoyed the noble scenery Although the height is 10,333 above the sea (barometer 528.1 millimetres), it is so much surrounded by summits still more elevated as to command no very distant scenery. But before us, to the north, rose the majestic form of Mont Collon, round which swept the

* Notice sur les Glaciers, p. 65.

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very extensive glacier which we had yet to traverse in its entire length during several hours; and to the eastward, beyond snow-fields of seemingly great extent, rose snowy peaks, which afterwards appeared to me to be the same as I saw from the col of Ferpêcle (or Erin), and over which it is just possible that a passage might be effected from the Val Biona to that of St. Nicolas, though, from the distance, it might probably be impossible to accomplish it without sleeping out on the glacier.

As we were far above the limits where water is found on the glacier, I used my portable furnace to melt snow for the use of the party, and afterwards to ascertain the temperature of boiling water, which I found to be 195°.15. We spent an hour of great enjoyment, for we now saw our way clearly, and all doubts were at an end of accomplishing a passage which, not to have performed, would have materially deranged our travelling plans; we then set forth in a cheerful mood to descend the long stretch of glacier which lay before us. There were few crevasses, —though whilst on the snow we walked with precaution and in a line, but without ropes:—we descended rapidly, whilst the majestic form of Mont Collon rose with increased grandeur before us. When we were fairly abreast of it, our guide set up a wild and sonorous shout which the rarely wakened echoes of those stupendous precipices sent pealing back again in tones yet more fantastic. He added that this echo was well known to the smugglers, and that the reverberation of Mont Collon served to guide them in foggy weather, in a track which must be then singularly perilous, from the great breadth and monotony

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of the glacier here, and the number of branches into which it divides in its higher part, any one of which might easily be mistaken for another.

Whilst we were amusing ourselves with the discordant shouts of the party and responses of the mountain, our attention was suddenly directed to a very different matter. A dark object was descried on the snow to our left, just under the precipices of Mont Collon. We were not yet low enough to have entered on the ice, but were still on snow. This proved to be the body of a man fully clothed, fallen with his head in the direction in which we were going. From the appearance of the body as it lay, it might have been presumed to be recent; but when it was raised, the head and face were found to be in a state of frightful decay, and covered with blood, evidently arising from an incipient thaw, after having remained perhaps for a twelvemonth perfectly congealed. The clothes were quite entire and uninjured, and, being hard frozen, still protected the corpse beneath. It was evident that an unhappy peasant had been overtaken in a storm, probably of the previous year, and had lain there covered with snow during the whole winter and spring, and that we were now, in the month of August, the first travellers who had passed this way and ascertained his fate. The hands were gloved, and in the pockets, in the attitude of a person maintaining the last glow of heat, and the body being extended on the snow, which was pretty steep, it appeared that he had been hurrying towards the valley when his strength was exhausted, and he lay simply as he fell.

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The effect upon us all was electric; and had not the sun shone forth in its full glory, and the very wilderness of eternal snow seemed gladdened under the serenity of such a summer's day as is rare at these heights, we should certainly have felt a deeper thrill, arising from the sense of personal danger. As it was, when we had recovered our first surprise, and interchanged our expressions of sympathy for the poor traveller, and gazed with awe on the disfigured relics of one who had so lately been in the same plight with ourselves, we turned and surveyed, with a stronger sense of sublimity than before, the desolation by which we were surrounded, and became still more sensible of our isolation from human dwellings, human help, and human sympathy,—our loneliness with nature, and, as it were, the more immediate presence of God. Our guide and attendants felt it as deeply as we. At such moments all refinements of sentiment are forgotten, religion or superstition may tinge the reflections of one or another, but, at the bottom, all think and feel alike. We are men, and we stand in the chamber of death. Our friend of Biona, though he was the first to raise and handle the body, from which the others rather shrunk,—and though he examined the rigid clothes for the articles which they contained, and with our consent took out a knife and snuff-box from the pocket, and a little treasury of mixed Swiss and Piedmontese small coins, concealed in a waistband all entire and untouched, (by means of which we could identify the person and restore the money to his friends),—though he performed all this with seeming indifference, we had no sooner left

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the spot than he declared that he would rather make a circuit home by the Great St. Bernard than return alone by this spot. Indeed it might well require resolution in a solitary man, with the chances of weather, to pass alone a col like this, where, supposing him caught in a *tourmente*, it would require no vivid sensibility to raise the image of the last sufferer before him, and hasten the moment of despair, when the spirit yields to the pressure of hunger, fatigue, and bewilderment, and subsides insensibly into the sleep which knows no waking.

A very little farther on we found traces of another victim, probably of an earlier date;—some shreds of clothes, and fragments of a knapsack; but the body had disappeared. Still lower, the remains of the bones and skin of two chamois, and near them the complete bones of a man. The latter were arranged in a very singular manner, nearly the whole skeleton being there in detached bones, laid in order along the ice,—the skull lowest, next the arms and ribs, and finally the bones of the pelvis, legs, and feet, disposed along the glacier, so that the distance between the head and feet might be five yards, a disposition certainly arising from some natural cause, not very easy to assign.

The glacier now enters a regular valley, and leaves the high slopes. It is bounded by Mont Collon on the left, sweeping for some miles round its base, and on the right by rugged cliffs, chiefly of gneiss, in which we could distinctly see well characterised granitic veins, shooting in irregular zig-zags through the mass. The glacier on which we now were is the glacier of Arolla, that which

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occupies the head of the western branch of the Vallée d'Erin. It is very long. Probably we might have continued most easily all the way along the ice towards the centre; but our guide advised us to follow the right bank along the moraine, an excessively rough and fatiguing scramble, for a great distance, on angular moving blocks, without a trace of a path. This was by far the most tedious and disagreeable part of our day's journey; but M. Studer was rewarded by finding a mixture of gabbro or diallage rock, in immediate connection with real granite and metamorphic gneiss, to which he attached considerable importance.

The structure of the glacier of Arolla is perfectly normal, presenting bands or veins nearly parallel, and vertical throughout a great part of its length, which sweep round in the conoidal forms, proper, as we have seen, to the lower termination or unsupported part of the glacier. The lower extremity is very clean, little fissured, and has from below a most commanding appearance, with the majestic summit of Mont Collon towering up behind. The frontal bands are very distinct, and even at a distance of a mile or more, those very marked ones which, in describing the Mer de Glace of Chamouni, I have called "dirt bands," and which, perhaps, are the annual rings or marks of yearly growth of the glacier, are beautifully developed, and recur at intervals marked with almost mathematical precision.

The stream which descends the valley rises from under an arch of ice at the foot of the glacier. The bottom of the valley is wide, gravelly, and waste. A number

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of desolate and stunted pine trees occupy the western bank, and seem chilled by the near approach of the ice; many are dead, and some fallen. They serve to give a scale to the majestic scenery behind. Their species is the *pinus cembra*, the hardiest of their class which grow to any size in Switzerland, and they are consequently to be met with at great elevations. This pine has various names. In the patois of Savoy, and many other places, it is called "Arolla," whence the name of the valley and glacier. It is also called "Arve," and "Zirbelnusskiefer." It yields an edible fruit, and the wood is soft and well fitted for carving, for which it is preferred, especially in the Tyrol and eastern Alps. This wood of pines lies exactly between the foot of the glacier of Arolla and a small detached one descending from the mountain called Pigno d'Arolla, a summit on the western side of the great glacier.

I ought to have mentioned, that in quitting the northern foot of Mont Collon, during our descent, we left upon our left hand a great tributary glacier, steep and difficult of access, which separates the Mont Collon from the Pigno d'Arolla, and which may possibly communicate with the icy mountain of Chermontane, beyond the head of the valley of Hérémence. We staid some time to contemplate the wonderful majesty of the scene, of which I made a sketch, and we then proceeded down the valley.

The châlets of Arolla were a little way lower, across the torrent on our left, and the shepherd who kept them, perceiving the unusual sight of visitors, came down to meet us, and courteously invited us to

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rest ourselves, which, as the day was not too far advanced, and the way was now plain, we willingly did, and partook of his cheese and hard bread, with excellent butter. The châlets had even a finer view of the glacier than that which we had quitted, and thus looking in front of it, I saw very plainly the succession of structural bands disposed with the remarkable regularity already alluded to. One of our first inquiries was connected with the fate of the unfortunate men whose relics we had observed; and it appeared that our entertainer, Pralong by name, had himself been one of the party to which the most recently deceased of these men belonged. They had started in the end of October last year (1841) to cross the col into Piedmont, in all twelve men; but being overtaken by a tremendous storm, they at length resolved to return; but too late for three of their number, who, worn out with fatigue, and benumbed with cold, were left behind,—the imperious calls of self-preservation requiring their abandonment. Our informant assured us, that he himself was the last to quit these unfortunate men in succession, when every effort to stimulate or assist them had been tried in vain. We understood that two of the bodies had already been recovered; the third was, no doubt, the one that we first saw. The articles which Biona had taken from the body were afterwards recognised in Evolena, and the money (which did not amount to more than three or four French francs) was faithfully paid over to the curé, and measures were taken to have the body brought down for interment.

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Our new acquaintance of Arolla gave us other information, which interested me as much. Having complimented us on the successful passage we had made, he asked us if we were not desirous of attempting the more arduous passage from Evolena to Zermatt, which, he assured us, that he and his father had more than once performed, and that they were indeed the only persons in the valley who had done so. Now this passage had long piqued my curiosity, having a sort of romantic interest, which attaches to what has been so seldom performed, as to render its possibility almost fabulous. It was certain that it must carry the traveller amongst some of the highest and most majestic peaks of this almost unknown district. Its elevation and character I had already studied in 1841 from the side of Zermatt, and had conceived the most lively curiosity to traverse these glaciers, and to ascertain the relations of a group of mountains 13 and 14,000 feet high, some of which are scarcely indicated on several of the latest maps. My great doubt had been as to the possibility of finding any guide in Evolena, and therefore, that the first man whom we met with in the valley should be the very person who, I knew from Fröbel's work, was reported to have some personal knowledge of this celebrated pass, seemed a piece of good fortune not to be lightly thrown away. After a short consultation with M. Studer, I found that the heavy marching trim of the worthy Klaus, and his own wish to visit the valley of Anniviers, would prevent him from undertaking this journey, although we were

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both eventually bound for Zermatt; therefore after a few minutes' arrangement I determined my plan, engaged Pralong to come down to Evolena next morning, and thence start with me in the afternoon for the foot of the Ferpêcle Glacier, where we might sleep, and attempt the passage the following day. Pralong desired nothing better, and we soon started for Evolena. The walk to Haudères, where the valley of Arolla joins that of Ferpêcle, the union of the two forming the Vallée d'Erin, was very agreeable, and at times beautiful. At the hamlet of Chatorma we noticed striated and polished rocks, of which, as has been already said, we saw none in the Val Pelline. Below St. Barthelemi the way becomes steep, the torrent descends in rapids, and the banks are clothed with larch and pine wood; the ravine is altogether grand and picturesque. We then came to steep watered meadows, and at length, crossing first one stream and then another, we arrived at the hamlet of Haudères. Half an hour, which seemed a tedious while, over a fertile flat, divided into grass fields, and thickly studded with barns, brought us to the capital of the valley, the village of Evolena, which seemed to us the largest place we had seen for some time. A nearer approach shewed that the houses, which looked so imposing at a distance, were built of logs, and had dark and uninviting exteriors. But when we came to seek for accommodation, we found every anticipation we could possibly have made of discomfort and privation much exceeded.

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CHAPTER X.

FROM EVOLENA IN THE VALLEY OF ERIN TO ZERMATT IN THE VALLEY OF ST. NICOLAS, BY THE GLACIERS OF FERPECLE AND ZMUTT.

A Night at Evolena—Wretched Accommodation—Departure for Abricolla—Aspect of the Glacier of Ferpêcle—A Night in the Châlets—Ascent of the Glacier—The Motta Rotta—The Stockhorn—Magnificent View of Monte Rosa and Mont Cervin—Dangerous Descent—Precipices—The Bergschrund—Pralong Returns—The Glacier of Zmutt—Structure of the Mont Cervin—Arrival at Zermatt.

We knew too well what accommodation might be expected even in the *capital* of a remote Valaisan valley to anticipate any luxuries at Evolena. Indeed, M. Studer had already been there the previous year, and having lodged with the curé, forewarned me that our accommodation would not be splendid. A change had, however, occurred in the establishment of the "Pfarrhaus" since 1841, by the introduction of the curé's sister, who usually lived at Sion, a person of ungovernable temper and rude manners, who seemed to find pleasure in the arrival of strangers only as fresh subjects whereon to vent her spleen, and to show how heartily she despised the inhabitants of her brother's

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parish compared to the aristocratic burghers of the decayed town of Sion. Had this been all, and had our corporeal wants been reasonably attended to, we might have forgotten the ill-nature of expressions directed at random against ourselves and all mankind; but we experienced the greatest difficulty not only in procuring anything to eat, but even in being allowed to cook our own provisions. The curé, a timid worldly man, gave us no comfort, and exercised no hospitality, evidently regarding our visit as an intrusion. Indeed, jaded by a fatiguing journey, without any prospect of beds, (for we had been told at once that we could not lodge in the *cure*,) we wished ourselves a hundred times, in the course of the evening, at the deserted châlets of Prarayon, where we had spent the former night; whilst the amiable family of A—— at Val Pelline seemed, by contrast, to belong to another race of beings. The faithful Klaus, too, had been taken unwell during the latter part of the day; but there was no alternative but to sit round a table, attired as we were, for two hours, before a soup, prepared with our own rice, was presented to us. At a late hour in the evening we were told that one bed could be had in the village; we gladly left the Pfarrhaus, shaking the dust from our feet, and went to the destined lodging, where we found civil, and tolerably cleanly people, whose jargon, however, it was quite impossible to understand. There was actually but one spare bed in the whole village. We drew lots for the prize, which fell to me. It was clean, though neither soft nor even;

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but between two such journeys as I was undertaking, even to undress was a luxury, and I slept till late next morning, when I was awakened by M. Studer entering. Where he had slept never transpired. He had, however, spent a night of misery, and came to communicate his intention of departing immediately for the Val d'Anniviers, instead of passing the day in the neighbourhood of Evolena, as he had intended. I could not gainsay the propriety of his determination, although sorry to part. He left shortly afterwards, and we agreed to meet at Zermatt,—he going by Visp, I by Ferpêcle.

Before I had finished dressing, our worthy guide from Val Pelline came to bid me adieu. During the latter part of our yesterday's walk we had become well acquainted, and his simplicity of character had touched us both. He had more than once expressed a wish to accompany us farther, as well as to avoid returning to his own country the same way. He urged nothing of the kind now, but quietly bid me good-bye and took the road to Haudères. When I saw him fairly gone, I could not but regret having parted with him so easily. I thought that he might be very useful in the more difficult journey which awaited me, my own servant being inexperienced, and the guide of Arolla, though he promised well, being quite unknown to me. I therefore ran after "l'habit rouge," and asked if he would accompany me to Zermatt, and return home by the Val Tournanche in Italy. To this he at once assented. There was no bargaining or hesitation, and he turned back with me.

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In the forenoon, Pralong joined me according to promise. Having first dined, I started with my three men about two o'clock, with very fine weather, intending to sleep at the last châlets of Ferpêcle, and to cross the glacier the following morning. Before quitting Evolena I will say a few words respecting the valleys of which it is the centre and capital.

The group of valleys of which we speak, and of which Erin is the chief, is situated between the Rhone and the great chain of Alps. Their openings into the valley of the Rhone are so small and unconspicuous that they are passed unnoticed by the traveller, rolling along in his private carriage, or that of the Simplon courier, almost without perceiving their existence; yet opposite to three well known stages on that road, Sion, Sierre, and Tourtemagne, three several valleys proceed, the Val d'Erin, or d'Herens, (Eringer Thal), the Val d'Anniviers (Einfischthal), and the Vallée de Tourtemagne (Turtmanthal). Their magnitude and importance are in the order just stated. The Val d'Erin divides into two branches, the valley of Evolena and that of Hérémence, both of which terminate in great glaciers—to wit, the glaciers of Ferpêcle, Arolla, and Lenaret. The Val d'Anniviers divides into the Val de Torrent and Val de Zinal, with glaciers of the same names. The valley of Tourtemagne is uninhabited, except in summer, and terminates in a glacier at the foot of the Weisshorn.

These valleys have not only been hitherto unfrequented by *tourists*, but are almost unknown even to *travellers* (to make a distinction commonly and not

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unjustly drawn in Switzerland). De Saussure says nothing of them. Bourrit speaks of them so slightly that it may be doubted whether he ever was even so far as Evolena. Ebel mentions them only to acknowledge his want of information, and Simond is silent alike on their history and existence. Even at the time I am describing, although it was past the middle of August, the curé informed us that we were the only strangers who had yet appeared that season at Evolena. A pleasant little work, by Fröbel, entitled, "Reise in die weniger bekannten Thäler auf der Nordseite der Penninischen Alpen,"* has given the first and only detailed account of them worth notice, and even his visit was one of but a very few days, and directed only to the more accessible points. His work is valuable from an improved map which it contains (upon which the index map in this work is partly founded), and which corrects many of the almost incredible errors of the best executed maps before that time, such as those of Weiss, Keller and Wörl. I should add, that a work published at Basel, also in 1840, by Engelhardt, under the tittle of "Natur schilderungen der höchsten Schweitzer Alpen," gives some account of these valleys, and confirms the unanimous testimony of travellers respecting the discomfort and incivility experienced at Evolena.†

It seems to be admitted by all who have mentioned

* Berlin, 1840.

† MM. Ulrich and Gustav Studer have more recently published the results of their journeys through these valleys, though ot, I believe, in a separate form (1854).

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these valleys that their population is of a distinct race from their Swiss neighbours. Very different origins have been assigned to them,—that they came from the east, and were originally tribes of Huns and Alani, and that they settled here in the fifth century, is the most prevalent theory; others pronounced them to be Saracenic, dating from the ninth century, whilst Fröbel inclines (chiefly upon etymological grounds, not perhaps very conclusive) to consider them a Celtic race. That they lived in a very independent manner, were heathens long after the conversion of their neighbours, became subject to the Bishop of Sion, and were christianized by his missionaries, is confidently stated. In modern times we know that they have shewn a spirit of stubborn independence, and resisted, in their unapproachable fastnesses, the incursions of the French armies, at a time when the rest of the Vallais had submitted to the yoke of Bonaparte.

Their character does not appear to differ much from that of the Vallaisans, or, indeed, of the Swiss generally. Their hospitality, according to Fröbel, is seldom disinterested, and an intense love of money predominates in all their transactions. A dollar which once finds its way to Erin is never changed, and never comes forth again. This feature, supposed generally to be an imported vice, conspicuous only on the great and frequented roads, is, therefore, not merely the result of English folly and extravagance; and my experience in other remote places confirms the opinion. The character of the people is, farther, according to the same writer, stiff and pedantic, not unfrequently producing

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a ludicrous appearance of self-importance amidst an utter neglect of the common comforts and almost decencies of life. Their food is not only coarse, but scanty, and even unwholesome; their houses and apartments are amongst the worst in the Alps: cleanliness is not amongst their virtues. Much of this may be traced to laziness, which Fröbel says is the prevailing vice: mules are abundant for country uses, and no man walks who can possibly ride (even second) on a mule; still less will any one carry a common knapsack without complaint. Klaus's *hotte* was the wonder of all who met us. Fröbel has, indeed, said so much about the impossibility of obtaining good guides in Evolena,* that I had despaired of undertaking any considerable expedition, but Pralong seemed to be rather an exception to the usual character, being active, civil, and far from exacting; he also displayed, on the whole, much personal courage and resolution.

The language is barbarous, but I doubt whether it is more so, or more decidedly national than in many other remote valleys of the Alps. The word "fläthig" for *cleanly*, which Fröbel has mentioned as distinctive, I have heard in the valley of Saas, where the population is, I believe, purely German. The name Evolena is said to mean, in the native dialect, "tepid water," and may be derived from a number of very beautiful springs, which rise from the fallen debris at the foot of the

* "Die Männer von Evolena sind schlechte Bergleute." "Zehn bis funfzehn Pfund auf den Rücken zu haben ist einem Manne von Evolena eine unerträgliche Unbequemchkeit," p. 91.

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mountain slope immediately behind the town. *Borgne*, means brook; *biegno*, glacier, and *pigno*, mountain top, which last Fröbel says is synonymous with the Spanish *penon*, the French *pignon*, the mons *penninus* of the Romans, and the Gaelic *bein*.

These valleys, notwithstanding the seeming poverty of their inhabitants, annually export a great deal of produce. Evolena is eight hours' distant from Sion. Its neighbourhood presents a very lively and fertile appearance, the valley being broad and well watered, covered with pasture, and studded with barns and châlets up to a great height on both sides; for although the secondary ranges, those which divide Erin from Hérémence and Anniviers, are of considerable height, and of a fatiguing nature to climb, as those who have passed testify, they are fertile and grassy, affording excellent pasture. The cheerful appearance is indeed diminished when we approach and find what seem to be villages to be mere barns, or rather hay-lofts, without a single inmate, and when, in the inhabited places, we find so much want of comfort and cleanliness. But as I have said, the exports of dairy produce to the low country are large, and probably very greatly exceed the imports, although these must include most of what are commonly considered as the necessaries of life.

Besides the natural entrances to these valleys from the valley of the Rhone, which, as we have said, are narrow and unconspicuous, there are various passes to and from the higher parts of these valleys. In former times, the glaciers were, as we have also seen, un-

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doubtedly much more accessible, and even the pass to Zermatt seems at one time, like the Col du Géant, to have been frequently used. From Hérémence, there is said to exist a passage to the glacier of Chermontane, which may have been in the direction which we saw in crossing the Col de Fenêtre. There is also a long pass, but not over ice, into the Val de Bagnes, below Mont Pleureur, which M. Studer crossed in 1841. From Anniviers, it is very doubtful whether any glacier-pass exists; but from Tourtemagne, which is a valley inhabited only in summer, it is possible to cross the northern part of the Weisshorn into the valley of St. Nicolas above Stalden.

But to resume our journey. Having quitted Evolena at 2 P.M.,* I walked to Handères, where my guide, Jean Pralong, lived. This village is at the junction of the two *Borgnes*, three miles above Evolena. It was nearly deserted. Pralong took the key of his house from under a stone, and invited me into it. The entrance was rude and ill-furnished, the light and air coming in on all hands; but he conducted me up a trap-stair to a very tolerable apartment, with clean-looking beds, which we should have envied the night before. He offered me wine, and took a supply himself for the journey, candles for our use at night, and various other articles, including a rope to be used on the glacier. We then started, and followed the east side of the eastern rivulet, that

* The height of Evolena is 4532 English feet above the sea by M. Studer's observation compared with the barometers at Geneva and St. Bernard.

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descending from the glacier of Ferpêcle. We followed narrow water-courses to abridge our way, and during our ascent I was surprised to notice the oriental plane-tree and the currant both growing wild. The rocks exhibit traces of glacier friction, but neither here nor in the other branch of the valley towards Arolla are the transported blocks numerous.

After two hours' walk from Evolena, we reached the châlets of Ferpêcle, the highest and only habitations of this part of the valley. Here we proposed to get some hay to form our bed at night, which we conjectured might be a scarce commodity at the still higher station, where we proposed sleeping. But this was not so easy a matter, for this seeming village contained not a single inhabitant; the greater part was composed merely of hay-lofts, which, upon examination, proved to be much better secured than at first sight seemed probable. But Pralong was not daunted by the resistance of wooden bars and iron shackles, and my geological hammer was unscrupulously applied to obtain an entrance with the deliberate purpose of pillage. At length one door was forced, and a good armful of dry clean hay was secured and carried off, and all else replaced as before. We had now the lower end of the glacier of Ferpêcle immediately before us. The valley is very deep, and the scene solitary and striking, but it is impossible to form here any idea of the extent of the ice. Keeping always to the left, we began a smart ascent at first over the moraine of the glacier, which here as elsewhere seems to have retreated of late years. At length we gained

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a better path, traversing high pastures, and crossing the beds of several vast torrents. Having now got considerably above the ice, we advanced nearly on a level. We also saw rising beyond, groups of jagged summits, which separate the glaciers of Ferpêcle and Arolla, of which the most conspicuous is a sharp pinnacle called Aiguille de Za. These terminate towards the great chain in a range called the Dents des Bouquetins. This led us to speak of those animals, and I asked Pralong whether any were ever seen. He replied that they had long disappeared, and that the story went that long ago the government of the Vallais, desirous to preserve the race, declared the shooting of a Bouquetin to be a capital offence, from which time not one of these animals has been seen,—a practical proof, he probably meant to infer, of the impotence of extreme legislation. He also began spontaneously to talk about the glaciers, and the cause of their motion, and put several very pertinent questions. Amongst other things, he affirmed distinctly, that the glaciers advance indifferently in summer and in winter, and even that if the lower extremity be diminishing, it continues to do so—if advancing, to advance also—in winter as in summer.

As the evening fell we gradually approached—by a path which certainly seemed to lead to no human habitation, but to an endless wilderness of ice and rocks—the châlets of Abricolla, which we reached in an hour and a half from the châlets of Ferpêcle. The first symptoms of human art were two pyramids of stone (*hommes de pierre*, as they are generally called), which

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directed us from a distance; then two stone huts near together, and one or two others a little beyond. We soon found that there were inhabitants, and we were received with simplicity, and with that composure and seeming absence of curiosity which I have already mentioned as remarkable amongst the *Pâtres* of the higher Alps. A visit even from Evolena is a rarity, but most likely none of them had before seen or lodged a traveller and his guides, prepared to cross the glacier to Zermatt. Nevertheless, as their reception was far from repelling or suspicious, I was well satisfied with their tranquillity about my concerns and objects; and preparing my arrangements for the evening, I left my guides, who all spoke different native tongues, to satisfy, as best they might, any latent curiosity of our hosts.

It was a charming evening, almost too mild to give quite a favourable prognostic for the weather. After sunset the moon, which was almost full, rose, and threw her light over a scene not to be surpassed. These châlets, placed on a broad-glassy shelf of rich verdure, overhanging, at a height of several hundred feet, one of the noblest glaciers in the Alps, are not much less elevated than the Convent of the Great St. Bernard—a position sufficient in most cases to diminish the effect of the higher summits, but which here only increases it, so stupendous is the scale of nature at this spot. Rising abruptly from the glacier, at no great distance on the left, is the grand summit of the Dent Blanche, which

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is called Hovenghorn as seen from Zermatt. Its height is probably unmeasured, but is marked in Keller's map 13,000 French feet, which, I believe, is rather under the mark. To the south the view is bounded by the ridge which I proposed passing, from which the glacier descends in some places very steeply, and with a striking effect, breaking over a rock called Motta Rotta, which divides its current for a short space. To the west of this a narrow ridge of angular summits, very abrupt and bare, divides the glacier into two distinct branches. This is called the Mont Miné, and is reputed to contain indications of ancient mines. I was surprised to learn that sheep are usually conveyed across the glacier to graze upon what seems a mass of broken rock. Between the Mont Miné and the ridge formerly mentioned as separating the glaciers of Arolla and Ferpêcle, the western branch of the Ferpêcle Glacier descends. This ridge is far higher, and more commanding than the Mont Miné. It has its origin at the Dents des Bouquetins, near the axis of the chain, and it descends to the Aiguille de Za, and continues to its termination above Handères, in the Dent de Visivi. From the considerable height at which I stood, the glacier was seen (in its lower part at least) in plan, and presented a view of the same description, but more extensive and wild, than that of the Mer de Glace from the Montanvert. As now seen by moonlight, its appearance was indescribably grand and peaceful, and I stood long in fixed admiration of the scene, the most

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striking of its kind which I have witnessed, unless, perhaps, I were to except a moonlight walk over the great glacier of Aletsch under very similar circumstances. Amongst other things, I did not fail to remark the wave-like bands, or "dirt beds," at regular intervals on the surface of the glacier, in precise correspondence with what I had observed at Chamouni from the Charmoz. Here they were, if possible, more striking, more numerous, and not less regular. Instead of 18 bands, I here counted 30 at intervals sensibly equal, and in forms like those figured on the map of the Mer de Glace. The moonlight was very favourable to this observation.

I soon after returned to the hut to supper. As might be expected, the cheer was not great, but cheerfully given. There could not be much less comfort than at Evolena; but it was at least freely offered. There was no temptation to prolong a stay within doors, unless to sleep. I retired early with my guides to the lodging prepared for us with the aid of the hay which we had brought. It was a small shed, about six feet square, and four high, attached to the principal hut, entered by a doorway through which one could creep with difficulty, and which was shut up with a piece of cloth. I was placed next the wall, and the others slept beside me. The shepherds themselves slept in a separate hut a little way removed. Before we went to rest, it was agreed that they should call us at 3 A.M., that we might be on foot before day, for all reports agreed, that whatever might be the difficulties of the

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journey, it was, at least, a very long one. In order to awaken us at the right time, they begged to have my watch with them for the night, a request which, in some other countries, might have been suspicious (it was a valuable gold chronometer), but which here I granted as readily as it was undoubtingly asked. As we lay down I was struck by the conduct of Pralong, who knelt down on the hay and said his prayers shortly, and without form or pretension of any kind; and we had not been long composed to rest, before we heard a solemn, and not unmusical voice proceeding from the neighbouring apartment. On enquiry of Pralong, I found that the practice of evening prayer is kept up amongst the assembled shepherds; a rare but touching solemnity amongst men of the common ranks,—for no women usually live in the higher châlets,—separated during so large a part of the year from the means of public worship.

I passed a sleepless, though far from an uncomfortable night. Pralong had spoken doubtingly of the weather in the evening, and I well knew that anything like uncertainty in that respect could not be hazarded on such an expedition, for which I felt more and more disposed as I got better acquainted with the scenery of this interesting chain. Every change of direction of the moon's rays falling through the open walls and roof of our shelter I mistook for a cloud, and felt fresh anxiety lest the hour of rising should be overpast, as it had been at Prarayon. I was up before the rest, and whilst the stars were shining bright, the moon having set, I

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performed my hasty toilet. It was some time before breakfast could be got ready, and, as usual, an hour and a quarter elapsed before we were fairly under way, exactly at a quarter to five.

It may not be out of place to mention here what was known respecting this pass, which has remained less celebrated than the Col du Géant, or the Strahleck (both of which it exceeds in height), because the valleys between which it communicates are, I believe, little known. I first heard of it from a guide at Zermatt, Peter Damatter, who told me, in 1841, that he had passed it, and that the town of Sion was visible from the top. He represented the distance as excessively great, so as with difficulty to be accomplished in a day. Venetz, the able engineer of the Vallais (to which canton this country belongs), wrote, in 1833, that this pass was so dangerous that he had never known but one man who had accomplished it;* whilst he mentions it as a proof of the great increase of the glaciers in modern times, that formerly it was in considerable use, and certainly, for the rare occasions that any one may be supposed to have business between Evolena and Zermatt, the circuit of three or four tedious days' journey by Sion and Visp is by no means cheering. Fröbel mentions, that some years before he wrote, several gentlemen of Sion effected the passage under perilous circumstances, having passed the entire day, from two in

* Mémoire sur de la Variation de Température dans les Alps de la Suisse, p. 7. I quote from a citation, not having the original by me.

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the morning until evening dusk, between the last châlets of Ferpêcle, and the first of Zmutt.* Making all customary allowance for exaggeration, I had good reason to take all precautions, and to start with the early dawn; indeed we were scarcely off when Pralong intimated that he feared we were already somewhat too late.

It will be recollected that, besides Pralong, the guide of Evolena, I had the trusty Biona of Val Biona, and Tairraz of Chamouni, as my attendants. The provisions, and my personal effects, made a burden so light for each, that even an Eringer could not reasonably complain; and taking leave of our hosts with thanks and remuneration, we hastened at a good pace to gain the glacier. But this was not the work of a moment. I have already said that the châlets of Abricolla stand on a shelf many hundred feet above the glacier; and, what is always disagreeable, our first step to mounting was a steep and uncomfortable descent. We had not left the châlets ten minutes when we found a foaming torrent to be crossed. Now, a plunge up to the knees in a river even ice-cold is a trifle in ordinary travelling, and might be considered a refreshing commencement of a long day's walk; but when that walk is to be of ten or twelve hours on a glacier, and over snows 11,000 or

* "Die Angaben über die Gangbarkeit dieses Passes sind sehr verschieden. Wie bei aller Gletscherpässen wird auch hier alles vom Jahrgange und von der Witterung abhangen. Der Herr Domherr Berchtold in Sitten welcher ich über denselben befragte bemerkte mir, es sey in jedem Falle 'ein Aventure,' uber ihn zu gehen."—FRÖBEL, p. 73.

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12,000 feet high, such a freak might endanger life or limb. Accordingly, while Pralong and Biona spluttered through, I sought an easier passage higher up, which I at length found, and was followed by the wary Savoyard. Without difficulties worth mentioning we gained the surface of the ice, having lost, however, in level, a height of perhaps 1000 feet; we then patiently and warily proceeded on our march,—

> To climb steep hills
> Requires slow pace at first: Anger is like
> A full hot horse, who, being allowed his way,
> Self-mettle tires him.

But an unlooked for interruption occurred. My guides were all seized with sickness within a few minutes of one another. Their breakfast (boiled milk) had probably been prepared in a copper vessel, not cleaned overnight; and though all hardy men, with robust stomachs, and accustomed to the universal milk diet of the Alps, they suffered distressingly from the poison. For myself, long experience had made me almost wholly avoid these messes, and every preparation of milk. I had drunk tea both night and morning, prepared in my portable boiler, and had filled my gourd with some of the same invaluable stomachic, which I now administered with effect to Tairraz and Biona, whilst Pralong declared that his casket, or *keg*, as it would be called in Scotland, of red wine, was worth all the tea in the universe. Happily, I suffered no uneasiness, and the others, being probably accustomed to the disorder, made light of it, and gradually recovered; meanwhile we pursued our

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way. We were now close under the rocks which bordered the glacier on our left, beneath the lofty peak of the Dent Blanche. Before us was the Motta Rotta, the rocky precipice already described as rising through the ice. At length the glacier became much crevassed, and we had a choice of difficulties, either to skirt the precipitous rocks on our left, or to make for the centre of the glacier on our right, with the chance of crevasses yet more impassable. Pralong, indeed, broached the notion of attempting the ascent of the glacier between the Motta Rotta and the Mont Miné, which, he said, would lead us more directly to the col; but he did not know that such a passage had been attempted, and as, upon examination with the telescope, I perceived an enormous *Berg-Schrund*, or well-defined crevasse, which separated the higher summits from the glacier steep, I preferred pursuing the direction in which he had already passed. We accordingly made for the rocks, and scrambled along and up them for a considerable way. We were preceded by a whole troop of chamois, eleven in number, which we startled upon the ice, and which took immediately to the cliffs. At length it became difficult to say whether the rock or the glacier was the more formidable opponent, and we regained, with some difficulty, the surface of the latter, being now more than on a level with the châlets which we had left.

The sun was only now rising behind the ridge of the Dent Blanche, the ice was still hard frozen and slippery. The glacier was very steep and rugged, but the crevasses were exposed and the walking was more

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difficult than dangerous, although once I was only withheld by my companions from slipping into a chasm. But the snow line was soon gained, and the surface being still crisp, our footing was sure, and the bed of snow too thick to create any risk from crevasses. We were on the north or shady exposure, always the easiest to mount, and had a fatiguing climb up dazzling snow fields, about 30° of elevation abreast of the Motta Rotta, which was on our right. Pralong took the lead manfully, and was now quite recovered from his indisposition. The heights of the Motta Rotta gained, the col might be said to be reached, for although snow fields of great extent separated us from it, they evidently presented no difficulty. It is, perhaps, only in this part of the Alps that such a prodigious extent of comparative table-lands of snow are to be found at such an elevation. New peaks began to rise before us, and especially the Mont Cervin, or Matterhorn, and the Dent d'Erin, whilst to the westward, the summits of Mont Collon, and the neighbouring chains, peeped over the wilderness of snow and ice. The col or pass lay now, Pralong told me, considerably to the right, but seeing just before us a snowy summit, which alone concealed from us the view of Monte Rosa, and the great chain of Alps in that direction, I proposed, as we had gained this height at a very early hour, and with far less difficulty than I expected, to climb to the top of it to enjoy the view. Now, Pralong was not one of those teazing, pedantic guides who will never listen to any opinion, and who make it a point to thwart a proposition merely to show their

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consequence, the more so if it offer a chance of delay. I liked him for his confidence and good temper. He admitted that a traveller's opinion might be taken, at least as to the course which would please him best; accordingly, we walked right over towards the precipice stretching from the Dent Blanche to the Stockhorn. As we approached it, I caught one of those glorious bursts of scenery of which all description must ever fail to realize the incommunicable grandeur, and one sight of which at once and instantly repays the traveller for days of toil and sleepless nights. Wandering on alone, as near the verge of the snow-crowned precipice as I dared venture (for there an unseen fissure in the compacted snow, some yards from the very ledge, might readily occasion the detachment of a mass, by the traveller's weight, into the abyss), I gained the summit of the Stockhorn, of which I had considerably overrated the height from where I first proposed the deviation, and was seated on its top exactly at nine o'clock.

I wish I could convey an impression, however faint, of the view to the east. The morning was calm, the sky pure, and the sun bright; indeed, there was not a breath of wind, though I was here at a height of 11,760 feet above the sea, or 600 feet higher than the Col du Géant; and this stillness, combined with the reflected sun heat, made the air feel perfectly mild, although, to my surprise, I found the thermometer to be only 34°. The whole range of Monte Rosa, including that prematical summit, scarcely inferior to it in height, called

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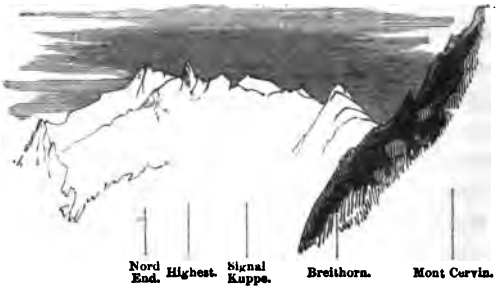
by some Montagne de Fée, and by others Mittaghorn,* filled the eastern distance. From the great height at



View of Monte Rosa from the Col d'Erin.

which I stood, there could be no doubt about which was the highest point. Although between 3000 and 4000 feet higher, the distance was so great as to bring the eye apparently almost on a level, and in no direction is the relation of these much contested summits better seen. The summit which I thus judged to be the highest is exactly the "Höchste Spitze" of Von Welden, 15,158 English feet above the sea, of which more hereafter.

The whole lustre of the morning sun shone shadowless upon these snowy heights, and upon the vast surface of the glacier of Zmutt, which lay completely, as in a map, at my feet, separated from me by stupendous precipices—"a vast vacuity." It is a cliff of which the Stockhorn on which I was seated forms at once the salient angle and the highest point. A

* What Von Welden has called "Berg X."

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branch of the glacier, comes close to the foot of the Dent Blanche, and to the base of the precipice. The Dent Blanche, thus seen in its precipitous height from top to bottom, had a magnificent appearance, and from the height which I afterwards ascertained of the point on which I stood, I cannot doubt that its reported height (nearly 14,000 English feet) is not overrated. Beyond the Dent Blanche, appeared the elegant and commanding summit of the Weisshorn, whose height, recently determined by M. Berchtold of Sion, is 14,812 English feet, and which sinks into comparative insignificance the Gabelhörner and other rugged mountains, which separate the head of the Val d'Anniviers from the glacier of Zmutt. But amongst the objects nearer at hand, even the Dent Blanche was not the finest. Right opposite, separated from me just by the breadth of the glacier of Zmutt, were the Mont Cervin and the Dent d'Erin, the former of 14,766 feet,* the latter conjecturally 14,000 feet above the sea. The unscaled and unscaleable pyramid of Mont Cervin is, beyond comparison, the most striking object in the Alps. The Dent d'Erin forms distinctly a part of the same range, united by a continuous and inaccessible precipice, and they are not isolated and unconnected masses, as represented in Fröbel's map. To the west-

* De Saussure. M. Berchtold's measurement is not sensibly different—namely, 13,839 French or 14,750 English feet, as stated by Engelhardt in the proceedings of the Swiss naturalists for 1841. The numbers given in Engelhardt's "Schilderungen" are many of them inaccurate.

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ward were seen the mountain groups of the head of the Val Pelline;—the Mont Collon, and the Pigno d'Arolla, the Dents des Bouquetins, and the seemingly interminable ice-fields over which (as I have said above) a passage might possibly be effected to the Col de Collon, above which I thought that I perceived the Mont Gelé, near the Col de Fenêtres; but in this I might easily be mistaken. It is probable that the Monts Velan and Combin might be seen in the same direction, but clouds rested on that part, and on that alone, of the horizon. I apprehend that Mont Blanc must be concealed by the mountains last named. To the north was the glacier of Ferpêcle, which we had ascended, stretched out in all its length, flanked by its aiguilles, and descending into the depth of the valley, in which we easily traced the village and church of Evolena, but Sion is certainly not visible.

Of all the views which I have seen in the higher Alps, none can compare with that from the Stockhorn of the Col d'Erin (as I propose to call this pass, which has not yet received a name). The unequalled view of Monte Rosa, and the centrical position with respect to three summits of the second (if not of the first) order, the Mont Cervin, Dent Blanche, and Dent d'Erin, which seem all so near as almost to be tangible, are sufficient to mark its character. The Weisshorn and the Cima di Jazi, as well as Mont Cervin, all border on 15,000 feet; so that, counting all the peaks of Monte Rosa but as one, we see at once at least five distinct mountains higher than the Finsteraarhorn,

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long esteemed the highest in Switzerland proper. Compared to the Col du Géant, the view is here more vast and savage, and the individual objects finer and closer; though the distant view of the chain of the Alps gives to the former a delightful and peculiar charm.

Before leaving this part of our description, I must say one word on the geography of this part of the chain. By Wörl's Map, or that of Keller until the edition of 1842, it would appear impossible that such a pass can exist as that which I am now describing. The chain of Alps (I write with Wörl's Map before me) is represented as turning from the Mont Cervin abruptly to the N.W.—as including the Dent Blanche at the southern foot of which the Val Pelline is made to take its rise (!) and then, as bending back again towards the head of the glacier of Arolla. Since the Dent Blanche is rightly placed between the glacier of Ferpêcle and that of the Torrent-thal, it evidently would have been impossible to reach Zermatt from Evolena without crossing into Italy, and recrossing near the Mont Cervin. Now, without detailing other varieties of error, the reality is, that the main chain of Alps is here well defined, and nearly straight, extending from Mont Cervin through the Dent d'Erin to the nameless summits south of Mont Collon, and at the true head of Val Pelline or Biona. The whole north face of Mont Cervin and the Dent d'Erin is a united and inaccessible precipice, which falls into the glacier of Zmutt, which extends far to the westward of both, not rising (as even Fröbel

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inaccurately represents it) immediately behind the Mont Cervin, but in the great ice-mass to the westward of the Dent d'Erin. Now, just where the glacier of Zmutt takes its rise, is the commencement of a great lateral chain on so stupendous a scale, as to create little surprise that it has often been mistaken for the great chain. The glacier of Ferpêcle descends from its north-western flank, where it forms the Col d'Erin and the Stockhorn, upon which we conceive ourselves stationed. It then expands itself into the mass of the Dent Blanche, which sends forth the ramification of the Dents d'Abricolla and Zatalane, which separate the valleys of Erin and Anniviers. From the Dent Blanche the chain takes an easterly direction, forming the summit called Moming in Erin, Triftenhorn at Zermatt (where the Dent Blanche is called Hovenghorn), which separates the valley of Zinal and that of Zmutt. This part of the chain seemed to me quite impassable. Then follow a range of peaks called Gabelhörner, which continue the chain in a north-easterly direction, parallel to the valley of St. Nicolas, until we reach the culminating point of the Weisshorn, a seemingly inaccessible peak of 14,812 English feet, which is often mistaken for Monte Rosa, especially from the pass of Gemmi, whence it and the other parts of the chain just mentioned have been elaborately figured in Von Welden's work as the *actual* Chain of Monte Rosa, and received specific names accordingly, although the real Monte Rosa is some thirty miles distant, and wholly concealed!

It will thus be distinctly understood that the passage

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of the Col d'Erin is not that of the great chain, but only of this ramification of it.*

M. Studer having taken his barometer with him to Anniviers, I had only the sympiesometer and the boiling water apparatus to depend upon for the determination of the height. I consider the latter as the most certain, and as probably not erring more than 50 feet from the truth. It gave (by comparison with the barometer at Geneva) a height of 11,770 feet, the temperature of boiling water, being 192°.45, (or 191°.93 corrected), and that of the air 34°. I melted snow, and caused the water to boil with great ease, even at this height, and thus supplied the party with plenty of water to drink, which otherwise it would have been impossible to procure.

Stretched upon the snow, we made a hearty meal; and the hour and a half which I spent here in observing my instrument, taking magnetic bearings of the principal objects, sketching the outline of Monte Rosa, and trying effectually to impress upon my memory a scene which I scarcely expect ever to see equalled or under circumstances so favourable, went quickly by; when Pralong modestly invited me to depart, as our task was far from accomplished; indeed, as it appeared, the most difficult part was to come.

Our object was now to descend upon the glacier of

* Since these chapters were written and first published, the topography of this country has become better known, through the labours of some of the numerous travellers who have since frequented it. (1854).

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Zmutt, of which, as I have endeavoured to explain, the lower or more level part swept along the base of the Mont Cervin and Dent d'Erin, whilst a higher stage of it rose to the foot of the lofty precipice above which we stood. Now, whilst the *top* of this precipice sunk from the summit of the Stockhorn, westwards to the col, and then rose a little, the glacier and the *foot* of the precipice rose rapidly and continuously to the westward, so that the top and bottom of the precipice became at length blended together, under a snowy sheet. To reach this point, however, would have been a long *détour*, and the glacier appeared dangerously crevassed. Having, therefore, descended from the Stockhorn to the col (which was not a great deal lower), Pralong proposed to attempt descending the cliff, by which he recollected to have passed when he last crossed, and to have successfully reached the glacier below. We began cautiously to descend, for it was an absolute precipice: Pralong first, and I following, leaving the other guides to wait about the middle, until we should see whether or not a passage could be effected. The precipice was several hundred feet high. Some bad turns were passed, and I began to hope that no insurmountable difficulty would appear, when Pralong announced that the snow this year had melted so much more completely than on the former occasion, as to cut off all communication with the glacier, for there was a height of at least thirty vertical feet of rocky wall, which we could by no means circumvent. Thus, all was to do over again, and the cliff was reascended. We looked

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right and left for a more feasible spot, but descried none. Having regained the snows above, we cautiously skirted the precipice, until we should find a place favourable to the attempt.* At length, the rocks became mostly masked under steep snow slopes, and down one of these, Pralong, with no common courage, proposed to venture, and put himself at once in the place of danger. We were now separated by perhaps but 200 feet from the glacier beneath. The slope was chiefly of soft deep snow, lying at a high angle. There was no difficulty in securing our footing in it, but the danger was of producing an avalanche by our weight. This, it may be thought, was a small matter, if we were to alight on the glacier below; but such a surface of snow upon rock rarely connects with a glacier without a break, and we all knew very well that the formidable "Bergschrund," already mentioned, was open to receive the avalanche and its charge, if it should take place. We had no ladder, but a pretty long rope. Pralong was tied to it. We all held fast on the rope, having planted ourselves as well as we could on the slope of snow, and let him down by degrees, to ascertain the nature and breadth of the crevasse, of which the upper edge usually overhangs like

Passing the Bergschrund.

* Upon the rock from whence we finally descended I left a bottle containing the names of the party.

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the roof of a cave dropping icicles. Were that covering to fail, he might be plunged, and drag us, into a chasm beneath.* He, however, effected the passage with a coolness which I have never seen surpassed, and shouted the intelligence that the chasm had been choked by previous *avalanches*, and that we might pass without danger. He then (having loosed himself from the rope) proceeded to explore the footing on the glacier, leaving me and the other two guides to extricate ourselves. I descended first by the rope, then Biona, and lastly Tairraz, who, being unsupported, did not at all like the slide, the termination of which it was quite impossible to see from above. We then followed Pralong, and proceeded with great precaution to sound our way down the upper glacier of Zmutt, which is here sufficiently steep to be deeply fissured, and which is covered with perpetual snow, now soft with the heat of the morning sun. It was a dangerous passage, and required many wide circuits. But at length we reached in a slanting direction the second terrace or precipice of rock which separates

* The annexed woodcut gives unquestionably an exaggerated impression of our position. It is attributable chiefly to the all but impossibility of inducing artists and woodcutters not to "improve" subjects submitted to them. The figures are greatly too small. Or, the correct proportion may probably be restored by supposing the crevasse half choked by avalanches of snow, as stated in the text. I have learned from two gentlemen who have passed here more lately, that they encountered no crevasse. This may have occurred either from the changes to which glaciers are subject from year to year, or from their having passed farther to the westward, where I have little doubt that the crevasse thins out entirely. (1854.)

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the upper and lower glacier of Zmutt, and which terminates in the promontory called Stöckhi. When we were fairly on the debris we stopped to repose, and to congratulate ourselves on the success of this difficult passage. Pralong then said that he wished to ask a favour of me. To my astonishment, this was that he might be allowed to return to Erin instead of descending the glacier to Zermatt. He was afraid, he said, of change of weather, and did not wish to lose time by going round by Visp. Of course I readily granted his request, and paid him the full sum agreed upon. To return all alone (and it was now afternoon) over the track we had just accomplished was a piece of spirit certainly remarkable. I almost hesitated at allowing him to expose himself, but he was resolved and confident, and having given him most of the provisions, and all the wine, we saw him depart.

We had still a long, though not a dangerous, stretch of glacier before us. We had, in the first place, to descend the precipices behind the Stöckhi to the lower level of the glacier of Zmutt. Though steep, and though the way was new to my companions as well as myself, we found no particular difficulty. We had now no alternative but to pursue the surface of the glacier of Zmutt for several miles, which proved a fatiguing walk enough, the ice being intersected by crevasses, and in many places almost covered with vast boulders. During this descent I had an opportunity of examining closely the structure of the Mont Cervin on this side, which probably no mineralogist has had before. There seems

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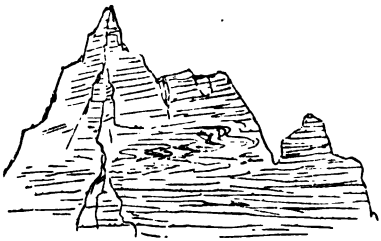
no reason to doubt that it is entirely composed of metamorphic secondary rocks. The lower part is of the system of *green slates*, which abound in this part of the



Mont Cervin from the N.W.

Alps, and which here pass into serpentine and gabbro, as the moraines testify, the higher part of grey and *white slates* remarkably contorted, and probably calcareous. The middle strata of the Mont Cervin appear to form by their prolongation, the Stöckhi on which I stood, and the Col d'Erin and Stockhorn are composed of a repetition of the green slate, which contains so much felspar that it may be called gneiss. The whole height of the Mont Cervin, down to the level of the glacier, is one continuous precipice, which must be between 7000 and 8000 feet. The conformation of the Dent d'Erin is similar to it.

The gradual appearance of the moraines upon the glacier of Zmutt was very striking. I mean that they are slowly developed upon the surface of the ice, as I have described on the Mer de Glace of Chamouni. They come from many quarters, and with a prodigious

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volume; from the Dent d'Erin, the Mont Cervin, the Stöckhi, the Stockhorn, and from other promontories divided by glaciers which fall from the range of the Dent Blanche and Triftenhorn, they accumulate at last upon so narrow a space of glacier as, from a distance, to appear to cover it entirely. The usual nearly longitudinal vertical structure was developed in the ice, where we first descended upon it. Both banks of the glacier were too precipitous to attempt to climb them, and for a long way we had to pick our steps as we best could on the ice and among the moraines. At length we gained the right bank, not far above the first châlets of Zmutt, with which I was already acquainted by my visit of the previous year. Immediately after, we entered the larch woods, and crossed the river where a very deep ravine is spanned by a most picturesque and insecure bridge, which passes to the village of Zmutt on the left bank of the stream. I walked very leisurely, enjoying the fine evening, and half an hour after reached Zermatt, where I took up my quarters in the clean house of the village doctor, named Lauber, which serves as an inn. I arrived at half-past five P.M., or in somewhat less than thirteen hours, from Abricolla, including various halts.

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CHAPTER XI.

THE ENVIRONS OF ZERMATT.

Valley of St. Nicolas from Visp to Zermatt—Torrents—The Bies Glacier—Position of Zermatt—Glacier marks on the rocks—Glacier of Gorner—The Riffelberg—View and bearings from it—Sketch of the geology of this part of the Alps—Simple minerals.

In 1841 I visited Zermatt in company with Mr. Heath, by the usual route from Visp in the Rhone Valley. It is about eight hours' walk; one and a half hours to Stalden, where the valleys of Saas and St. Nicolas separate, (see the general map;) two and a half to St. Nicolas; two to Randa, and two to Zermatt. Between Visp and Stalden the country is very pleasing, especially where the river is crossed at Newbrück, whence there is a very fine view of a small portion of the snowy range which separates the valleys of Saas and St. Nicolas. Near Stalden are earth pillars, capped by boulders which have protected the soil beneath from the rain, which has washed all the neighbouring parts away, and left these standing, not unlike the marks left by workmen to show the extent of an excavation. Similar columns are likewise to be found near Usegne in the Val d'Erin, at St. Gervais, at Botzen in

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the Tyrol, and near Queyras in Dauphiné. The boulders here seemed to be gabbro or diallage rock. From Stalden to St. Nicolas the valley is somewhat monotonous; but the Weisshorn is a striking object. I did not trace here any decided marks of glacier action.

Between St. Nicolas and Randa several wild and bridgeless torrents have to be crossed, which, in bad weather, must make this route nearly impassable. I noticed particularly the mode in which a violent torrent accumulates boulders, forming a mound of blocks on either hand, which serves, in some measure, to restrain its fury, whilst the level of its bed is continually raised by the detritus which it accumulates; and when, by extraordinary freshes, the barrier is broken, the country on either side is, of course, deluged. I only speak now of the wildest and most powerful torrents descending at a great angle, and which act sufficiently on blocks to roll them with the aid of gravity for a great way, and chafe them into irregularly rounded masses, with a noise which every one who has visited the Alps recalls as one of the most striking of natural sounds, accompanied, as it always is, with an impression of irresistible force. Now these rocky accumulations have a very striking resemblance to the moraines of glaciers, and this is a circumstance which it is well to be aware of, and which has not, I think, been prominently stated. In *form*, these mounds resemble moraines, the external, and even the internal slope, being in both cases usually determined by the *angle of repose* of the blocks. The *mate-*

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rials of both are also alike;—angular blocks, more or less rounded by friction, never quite smooth or polished, angular gravel, and sharp sand. In the *disposition* of the materials, I have not observed that regularity of arrangement which is said to distinguish water-action from that of glaciers. On the contrary, the deposit of these torrents seems to be wholly devoid of layers of coarser or finer materials, and, as in true moraines, the largest blocks often lie uppermost. I may mention the great torrent descending from the Dent du Midi, which devastates the country above St. Maurice, as another example of this.

The village of Randa lies amongst extensive meadows, and although on the opposite side of the valley from the Bies-Gletscher, descending from the Weisshorn (which is now left behind on the right), it has twice materially suffered from the lower part of that glacier giving way and filling up the whole bottom of the valley, in 1737 and 1819.* Above the village of Tesch the valley contracts, and a rocky barrier has to be surmounted. From thence a grand view of the Mont Cervin opens; and soon after, the village of Zermatt, charmingly situated in a green hollow, well flanked with wood, and enclosed by snowy summits, comes into view. It is at the rocky barrier just mentioned that I noticed the first clear traces in this valley of ancient glacier action in the polishing and striating of the surfaces,—a remarkably well defined result,

* Engelhardt, Naturschilderungen, p. 175. Agassiz, Etudes, p. 158.

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which may be traced at intervals up to the very foot of the glacier. These striæ were distinctly found by M. Agassiz in 1839, under the glacier itself. This is one of those cases in which it seems impossible to deny this to be a conclusive proof of the ancient extension of the ice.

The village of Zermatt (called Praborgne, in Piedmont) is near the union of three glacier-bearing valleys, —the main valley, at the head of which is the great glacier of Monte Rosa, called also the glacier of Gorner, or glacier of Zermatt; the valley immediately to the east, which contains the glacier of Findelen, descending from the Saas-grat; and that on the right, or to the west, headed by the glacier of Zmutt.

The river Visp takes its rise in these several valleys, and especially from the great glacier of Monte Rosa, where it issues, as usual, from a cavern in the ice. I measured its temperature in 1841, at different points of its length, which I found to be,—

Under the glacier . .	33°.3 F.
At Zermatt . . .	35°.5.
One hour below St. Nicolas	41°.0.
Half an hour below Stalden	43°.0.

The great glacier of Monte Rosa terminates at present about three miles above Zermatt. The lower part is too steep to be ascended, and it presents the phenomenon of conoidal bands, not only falling forwards until the frontal dip is nothing, but actually sloping outwards as in glaciers of the second order. It rests on serpentine and talc slates, and these rocks present

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exquisite proofs of glacier polish on the sides of the Riffelberg up to a very considerable height above the western bank of the glacier. Its breadth is here not great, and the surface is crevassed in a remarkable manner, as it rounds the promontory of the Riffel, like the rays of a fan which M. Agassiz has well represented in his atlas, as well as the medial moraines on its surface (which are numerous, and well defined), and their origin at the rocky promontories separating the glacier streams which descend from the Breithorn, the Lyskamm, and Monte Rosa. It is difficult to ascend the rocks on the eastern bank of the glacier, but it is possible; and when the upper surface of the ice begins to be commanded, there are one or two ruined huts in which a shepherd seeks a temporary shelter, and which may serve as a landmark. Near this the serpentine rocks are beautifully excavated in nearly horizontal striæ, whilst below, in the immediate neighbourhood of the ice, I found not only grooves but scratches well marked on the serpentine and talc slates. These scratches visibly crossed one another in two series, *under a considerable angle*, and this must be recent work, because the weather soon wears this rock.

When the upper level of the glacier is viewed, either from the Riffel or from the path up to the col of Mont Cervin, it presents a noble scene. It is a very vast ice river, whose surface, at the height from which it can be most conveniently observed, appears nearly even, though diversified by fissures and by structural bands like those on the Mer de Glace, which, so far as

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I can judge from the general view which I obtained without walking over it, are most distinct upon the southern half, and present complete loops bounded by the medial moraine, whilst the northern half (I mean of the breadth of the glacier) has probably a similar structure, although less distinct, and in one part, near the foot of Monte Rosa, is evidently much contorted. The tributary glaciers descending from the Breithorn have also a well-developed system of bands, quite normal.

But the Riffelberg may be more easily ascended by its northern slope; there are, indeed, several paths, but it is a stiff walk of nearly three hours from Zermatt. The view corresponds to that of the Montanvert of Chamouni. Though much more vast, I doubt whether the impression of this glacier, and the chain beyond, is altogether so interesting as the other. Monte Rosa is indeed very high and very large, but it presents too many points and too many masses of nearly equal height; the view wants concentration to make a picture, and variety of form. I except, however, the Mont Cervin or Matterhorn, which is seen from hence, but in an opposite direction from Monte Rosa, and which I have already noticed as beyond comparison the most striking natural object I have seen,—an inaccessible obelisk of rock not a thousand feet lower than Mont Blanc! The summits of Monte Rosa, distinctly seen from the Riffelberg, are the "Nord End," and "Höchste Spitze," of Von Welden's Map; then follow to the westward, the somewhat heavy looking range of the

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Lyskamm and Breithorn, terminating in the Petit Mont Cervin and Col de St. Théodule, a snowy chain of 11,000 feet, which is connected with the Mont Cervin. To the west is perfectly well seen the glacier of Zmutt, the Col d'Erin, and the range of the Hovēnghorn (Dent Blanche), and Gabelhörner as far as the Weisshorn. To the north is the lateral, though very elevated and all but impassable, range which separates the valley of Saas from that of St. Nicolas, which is called the Saasgrat, and of which the culminating point is (according to Berchtold of Sion) no less than 14,574 feet above the sea. It is, I believe, variously called by different writers and guides, the Dom, Montagne de Fée, Mittaghorn, and perhaps by some erroneously, Cima di Jazi.* Nearer at hand are the Stralhörner, and close to the north foot of the Riffel is the glacier of Findelen already mentioned, which unites to the eastward with the great glacier of Monte Rosa, and which must be ascended in order to reach the Weiss Thor, a very remarkable pass leading to Macugnaga, which I shall mention later. Though the glaciers of Findelen and Gorner have thus a common origin, the former has been retreating (at its lower end), the latter advancing for many years; this is a difficulty of which I know no plausible explanation. Peter Damatter, my guide, both in 1841 and 1842, asserts positively, that the glacier of Gorner advances in winter, and *more* in winter than in summer; but by

* The Topography of this range has received considerable illustration since these chapters were written from the adventurous expeditions of MM. Gustav Studer and Ulrich.

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this is to be understood that the lower extremity advances faster into the valley; being, of course, protected from thawing influences, its advance would be more perceptible. Upon questioning him closely, he declared that he had seen the glacier press on the snow before it; and that, in January 1840 in particular, it had advanced towards a fixed mark no less than 50 *klafter* (fathoms) in three weeks; a result, however, which we must be allowed to doubt.

The top of the Riffelberg is a peak, or "horn" as it is called in German Switzerland, which long passed for inaccessible, as no guide at Zermatt had attained it. In 1841, I attempted it by the western side, and arrived within a few fathoms of the top, when I was stopped by a cleft and a precipice which was not to be ascended without incurring a needless risk. In 1842, however, some English students of Hofwyl, clambering about the rocks, found a circuitous path on the eastern side, by which the top may be gained without much difficulty; I accordingly mounted it with Damatter, who had learned the way, and proceeded to take some bearings from the summit, which is a narrow rugged space. At first I thought Kater's compass pointed wrong; the sun, which was near setting, appeared due north! Then I took another compass, and got the same result. It was clear that there was an enormous local attraction of the hill on the needle. We would charitably wish this to be considered as a possible explanation of some portion of the inconceivable errors of the more esteemed maps of this part of the Alps; errors which something

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like an oversight of 60°, as in the present case, would seem alone capable of accounting for.* It appears, therefore, that the slaty beds of the Riffel are highly magnetic, probably from octohedral iron, which is found in large crystals on the neighbouring glacier of Findelen.

I take this occasion of adding a few remarks upon the relations of the rocks in this part of the Alps, which have been only incidentally mentioned. In doing so we must carefully distinguish statements of fact from theoretical statements. The former include the general distribution of rocks of certain mineralogical characters throughout the chain, as for instance granites, and the position and arrangement of the stratified rocks connected with them. The nomenclature of these rocks, and the

* I will, however, preserve the bearings I took, including an azimuth of the sun, which may serve to correct the others, and which may possibly be of use. They are expressed in degrees, round the circle from N. by E.

BEARINGS FROM RIFFELHORN.

Stockhorn, (Col d'Erin) . . .	5½°
Dent Blanche, (Hovēnghorn) . .	23
Triften-horn, (Moming) . . .	54
Weisshorn	70
Mont Fée ? (Saas-grat) . . .	139
Monte Rosa, (Höchste) . . .	204
Petit Mont Cervin . . .	289½
Sun's Azimuth, 21st Aug. 1842, 4h. 34m.	349
Mont Cervin	351

Now, the Riffelhorn bore 120½° from the Stockhorn. Supposing that observation correct, the Stockhorn ought to have borne 300½° from the Riffel; but it appeared to bear 5½° (or 365½°), consequently the local error was 65°!

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limits of formations, may at present be considered as in some degree hypothetical.

The granite of the Alps appears at intervals along the chain as if it were continuous below, but breaking forth only here and there, and affecting various other rocks with which it is intermingled, constituting, as M. Studer has most prominently brought into notice, a series of distinct centres, rather than long lines or axes of elevation. At the same time, we undoubtedly find a linear arrangement amongst these granitic groups, and frequently indications of true granite where the rock does not occur in mass, as in the granite veins of the higher part of the Val Biona, and of the valley of Arolla, and at Valorsine. It is not unfrequent that a secondary or parallel outburst of granite takes place, so that the chain appears to have two if not three axes. This is well-marked in the range of the Aiguilles Rouges, near Chamouni, and something of the same kind will probably be found in the Val de Bagnes, the head of the Val d'Anniviers, and in the valley of Saas. M. Studer has indeed mentioned the Dent Blanche as a granitic centre. I do not recollect to have seen granite blocks on the glacier of Ferpêcle, but I cannot be certain. The Stockhorn is certainly slaty. Now, though slaty rocks containing felspar are often in contact with alpine granite, it is impossible to consider them as representing universally the gneiss formation of other countries. In the first place, the granite as often, or oftener, *overlies* the slate than the contrary. These slaty rocks may be distinguished by mineralogical character, but scarcely by

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any other. They are quartzose, or micaceous, or calcareous, or contain serpentine, and are in colour white, grey, black, or green, and these colours are amongst the most distinctive characters which they present. Thus, there are the black slates of Fiz and the Bonhomme, near Chamouni, while the greater part of the mountains we have lately been describing are composed of regularly stratified alternations—felspar-slate, (gneiss), quartz slate passing into quartz rock, talc slate (*schistes verts*) passing into serpentine and diallage, and calcareous slates passing into dolomite, which last occurs in several repetitions in the section of strata formed by the valley of the Visp (or Viège). The talc slate also passes into pot-stone, which is worked near the town of Viège (Visp), and above Evolena. The Col of Erin is a felspathose slate or gneiss; the Stöckhi is a white quartzose slate, probably containing lime, and this appears to constitute the whole of the higher part of the Mont Cervin, whose unapproachable precipices will for ever prevent the geologist from a nearer survey. I have already said that the middle strata are contorted, and probably calcareous, and that the lower part, together with the Hirli —an accessible promontory at the foot of the pyramidical part on the side of Zermatt—is composed of the green slates passing into serpentine and gabbro. The mineralogical descriptions of De Saussure of this part of the Alps are intelligible and exact, and, with the exception of his attempt to classify the rocks amongst the regular primary deposits, may be considered to be nearly as precise as any that could now be given. For the sake

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of condensation, I may add, that the Riffel, and nearly all the chain of Monte Rosa, are composed of similar beds, which generally rise towards the eastern points, on the north side to the south-east, on the south side to the north-east. De Saussure says distinctly that the beds of the Mont Cervin rise to the north-east at an angle of 45°; my impression was, that they are less inclined or nearly horizontal, but De Saussure is no doubt correct.* His opinion of the arrangement and materials of the beds composing it I find to coincide accurately with my own observations on the spot.

The highest part of Monte Rosa, judging from specimens brought from the last accessible point by M. Zumstein, is mica slate. The whole system of Monte Rosa, as already said, rises to the east, and the first regularly crystalline rocks we meet with are near the Pizzo Bianco, above Macugnaga, which will be mentioned farther on. With respect to the age of these various rocks, few geologists are as yet disposed to decide with much confidence. I have already observed, that the division between true primitive gneiss and mica slate, and rocks of the same mineral character, which may be traced continuously into beds containing lias fossils, seems to be an arbitrary distinction, and one upon which no two observers could exactly agree. The age of the felspathic and micaceous slaty rocks, may be considered as open to discussion. The others—namely, the grey and green slates which I have described, are included by M. Studer under the general name of *Flysch*, a widely

* Voyages, § 2243.

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spread formation in Switzerland, but whose superposition is too irregular and uncertain, and the series of formations too imperfect to afford any clue to its age, whilst the one or two fossils which have been found in it seem to point to an age newer than the lias, and older than the medium chalk formation. What an overturn of all ancient ideas in geology to find a pinnacle of 15,000 feet high, sharp as a pyramid, and with perpendicular precipices of thousands of feet on every hand, to be a representative of the older chalk formation! and what a difficulty to conceive the nature of a convulsion (even with unlimited power) which could produce a configuration like the Mont Cervin rising from the glacier of Zmutt.*

Some pretty minerals are collected near Zermatt, principally from the moraines of the glacier of Findelen. The most remarkable is one of the talc family, a silicate of magnesia called *Pennine*, which occurs well crystallized in talc slate. It is blackish green by reflected light, and by transmitted light it is dichroitic, being of a brown orange in one direction, and of a bright green in another. On the Riffel, I found a large vein of an imperfectly characterized mineral, which M. Studer considers to be a variety of kyanite. A considerable variety of garnets, particularly the black kind, are found at Findelen, as well as octohedral iron.

* Since these chapters first appeared, Professor B. Studer has published (with Mr. Arnold Escher) his geological map and description of Switzerland (1854).

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CHAPTER XII.

FROM ZERMATT TO GRESSONAY BY THE COL OF MONT CERVIN.

Detainment at Zermatt—Ascent of the Pass of Mont Cervin—The Col—Fortifications—The Descent—Highly Electric state of the Atmosphere—Custom-house Officers—Breuil—Val Tournanche—Chamoix—Col de Portola—Val d'Ayas—Brussone—Col de Ranzola—Arrival at Gressonay—M. Zumstein.

> Never till now,
> Did I go through a tempest dropping fire.
> * * * * * * *
> A common slave (you know him well by sight)
> Held up his left hand, which did flame and burn
> Like twenty torches join'd; and yet his hand,
> Not sensible of fire, remain'd unscorch'd.
>
> *Julius Cæsar, Act* 1, *Scene* 3.

In 1841 I had been prevented from crossing the celebrated pass of Mont Cervin along with my friend Mr. Heath, and in 1842 another accident threatened again to make Zermatt the limit of my journey. A trifling injury to my foot, received on the Mer de Glace at Chamouni, and which had not appeared to get worse during the severe walking which I had since performed, assumed a more serious appearance during a day or two of comparative repose which I passed at Zermatt, wait-

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ing for M. Studer's arrival from Visp. I became a close prisoner, for nearly a week, at the little inn at Zermatt, where I was fortunate in finding much comfort and attention from the worthy Madame Lauber. The weather had altered for the worse, which diminished my regret at the detention, and I had the advantage of M. Studer's company. My friend was, however, resolved to lose no more time than the weather rendered necessary in resuming his journey, and as my foot was now convalescent, I consented to accompany him, on a morning of somewhat doubtful promise, when we were called by the faithful Klaus, whilst the stars were still shining bright through the wild drift of cloud. The impatience of the guides on such occasions is not the least of the evils of detention. My Savoyard, who spoke not a word of German, pure or impure, (and nothing else was understood at Zermatt,) suffered the horrors of *ennui* to an extent which might be thought to belong exclusively to the loungers of our great cities; and but for a small speculation in the minerals of Findelen, which he fully counted upon disposing of with a profit of 200 per cent at Chamouni, he very probably would have insisted on walking off to enjoy the daily fund of summer's gossip of his native valley.

We set forth about half-past 4 A.M., and having crossed the torrent of Zmutt, wound slowly up the steep pastures which skirt the western edge of the glacier of Gorner. We gradually attained a considerable elevation above its surface, before crossing another torrent, which descends from the Boden-Gletscher,

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which we left upon our right. In the preceding year I had ascended thus far, and crossed the Boden Gletscher to the foot of the Hirli, where there is a gloomy *tarn* called the Schwartzen See, beyond which is a fine view of the northern precipice of the Mont Cervin, and of the glacier of Zmutt. Those who do not propose to pass the Col of St. Théodule may thus make a very interesting excursion, and return by the châlets of Zmutt. Now, however, we kept right onwards, and a little after seven we reached the edge of the glacier which we had to traverse. Its surface is tolerably level, it is very extensive and desolate, not being included between bold walls as in the lower glaciers, but occupying a sort of vast table land, at an average height of nearly 10,000 English feet above the sea. We had an opportunity of appreciating its desolation, for we were repeatedly enveloped in the rolling mists which swept over the col, and which appeared to boil up tumultuously from the side of Italy, which we were approaching, and to be repelled on the Swiss side by an uncertain north wind. This wind secured us, however, a fine view of Monte Rosa, and of the chain of the Weisshorn; but I learned nothing new of the topography of either from this point, nor does the panorama admit of comparison with that from the Col d'Erin. Even the Matterhorn (Mont Cervin), which, however, we saw imperfectly, loses its apparent height, since here it rises only from the ridge, already at a height of 11,000 feet. Having walked already for a long time over snowy flats, we entered a kind of defile

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as we approached the col. The mists closed round us, and a stranger might very easily have entirely lost his way, for the defile presented many accessible points; our guide, Damatter, however, took the matter very coolly, and brought us safely to the col. The weather was damp and raw, and we had no view. We had been five hours and a quarter constantly ascending from Zermatt. We hastened to observe our instruments. The temperature of the air was 35° Fahrenheit, and the barometer stood at 511.53 millimetres, 3½ millimetres above what I had observed it at the Col du Géant. The height above the sea comes out 10,938 English feet, by a comparison with the barometer, both at Geneva and St. Bernard.

The Col du Mont Cervin, or St. Théodule, consists of felspar slate, or gneiss, and exhibits well preserved traces of a rude fortification, called "Fort du Saint Théodule." De Saussure says, that it was erected two or three centuries ago by the inhabitants of Aoste, to prevent an invasion of the Valaisans. "Ce sont," he adds, "vraisemblablement les ouvrages de fortification les plus élevés de notre planète. Mais pourquoi faut il que les hommes n'aient érigé dans ces hautes regions un ouvrage aussi durable que pour y laisser un monument de leur haine et de leurs passions destructives." Certainly there is nothing more jarring to the impressions of stern grandeur and vast solitude than the not unfrequent occurrence of military works in many parts of the Alps,

"High heaven itself our impious rage assails."

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The pass of the Col de la Seigne, at the head of the Allée Blanche, and more than one of the very savage cols near Monte Viso, bear witness to this strange anomaly.

We were disappointed of the fine view which we ought to have seen towards Aoste. Fortunately the clouds cleared so far as to let us see our way across the remaining part of the glacier on the Italian side, which is much steeper than the other, and consequently traversed by extensive rents, which being covered knee-deep with snow freshly fallen during the last few days of bad weather, were, in some places, not a little dangerous. The pass of the Mont Cervin appeared to me, on the whole, a more considerable undertaking than I had expected. Knowing that it is frequently traversed in favourable seasons by horses and mules, I expected to have found the glacier both shorter and easier. This season, indeed, no beast of burden had crossed, and it appeared almost inconceivable how they ever could; but such is certainly the fact, and we saw more than one trace of animals which had perished in the passage. Another circumstance which led me to expect an easier passage than we found it, was the ludicrous outfit of our friend Peter Damatter, the guide of Zermatt, who, instead of bringing a good ice pole and cord, as he ought to have done, being aware of the fresh snow, had provided himself merely with an umbrella. He was glad to borrow a stick from one of the party to sound his way on the Italian side, although we alleged that he used it with little dexterity; but the snow was literally

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knee-deep, and we encountered several wide crevasses, into one of which Tairraz had almost fallen, although he was the last of the party who had trodden in the guide's footsteps. Had he unfortunately done so, we should have had difficulty in extricating him for want of a rope. When he recovered his footing, he looked as pale as a sheet, but proceeded quietly.

At length we were free of the glacier, and recovered a track by no means obvious, which leads to the châlets of Breuil, leaving upon our left hand the longer and more difficult route by the Cimes Blanches conducting to St. Giacomo d'Ayas. The atmosphere was very turbid, the ground was covered with half-melted snow, and some hail began to fall. We were, perhaps, 1500 feet below the col, or still above 9000 above the sea, when I noticed a curious sound, which seemed to proceed from the alpine pole with which I was walking. I asked the guide next me whether he heard it, and what he thought it was. The members of that fraternity are very hard pushed indeed, when they have not an answer ready for any emergency. He therefore replied with great coolness, that the rustling of the stick no doubt proceeded from a worm eating the wood in the interior! This answer did not appear to me satisfactory, and I therefore applied the *experimentum crucis* of reversing the stick, so that the point was now uppermost. The worm was already at the other end! I next held my hand above my head, and my fingers yielded a fizzing sound. There could be but one explanation—we were so near a thunder cloud as to be

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highly electrified by induction. I soon perceived that all the angular stones were hissing round us like points near a powerful electrical machine. I told my companions of our situation, and begged Damatter to lower his umbrella, which he had now resumed, and hoisted against the hail shower, and whose gay brass point was likely to become the *paratonnerre* of the party. The words were scarcely out of my mouth, when a clap of thunder unaccompanied by lightning, justified my precaution.

At length we got below the level of the clouds, and the first shelter we reached was the wretched retreat of two Sardinian *douaniers*, who had lighted a fire under a portion of the remaining arch of what had once been a pretty solid edifice, probably a cowhouse; stones being plentiful, and wood the reverse, this mode of roofing had been adopted. They received us with civility, and allowed us to dine by their fire; and as we had been on foot for eight hours, we were entitled to some repose. The absolute discomfort in which this class of men live is greater than in almost any other profession. Hard diet, constant exposure, sleepless nights, combined with personal risk, and still more galling unpopularity, great fatigue, and perpetual surveillance, are the ordinary accidents of their life. Liable to suspicion when they quit the wildest and most inaccessible parts of the chain where a smuggler may by possibility pass, posted for hours together on a glacier 9000 feet above the sea, and, like animals of prey, taking repose during daylight in some deserted hovel in their wet clothes—one cannot but

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conclude the smuggler's life to be luxury compared to the protracted sufferings of their detectors. On many frontiers the *douaniers* are a slovenly and self-indulgent race; but on others I know that this is no exaggerated picture of their lives, even in the finest season of the year.

We descended to Breuil, a group of châlets pleasingly situated at the first green level in the valley, where we arrived at two o'clock, having staid an hour with the *douaniers*. The scenery of the head of the Val Tournanche, in which we now found ourselves, is very striking. The Mont Cervin, which owing to the clouds, we saw imperfectly, is the most conspicuous object, and next to that the excessively rugged range which stretches away from the Dent d'Erin as a centre, and forms the boundary between the Val Biona and Val Tournanche; the Dent d'Erin itself rose in terrible majesty. We noticed what appeared to be an ancient moraine descending from between the Mont Cervin and the Col we had passed, exactly where, according to the general belief, the former passage existed—namely, close under the Mont Cervin itself.

We performed the road from Breuil to the village of Val Tournanche leisurely, having the afternoon before us. In one place the valley becomes contracted, and the torrent dashes through a picturesque ravine, which exhibits distinct traces of glacier action as well as the friction due to water. Transported blocks are not numerous. Below this occur the first permanent habitations, and Val Tournanche itself, which would be a pretty village any where, seems a paradise to one

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descending from such savage scenery as we had left. The valley, though narrow, and partly bordered by precipices, has yet an undulating grassy bottom, with well watered meadows. The heights are clothed with pines, and the cottages peep out through walnut trees, as well as the spire of the village church, which has an Italian character. There is no inn, but we were received and hospitably entertained by the Reçeveur des Douanes, with whose subordinates we had dined.

Next morning we proceeded to cross the lateral chain which separates the Val Tournanche from the valley of Ayas or Val Challant, to which, as has been already said, there is a direct passage from the Col of St. Théodule. This is the first of a series of ridges which require to be passed in succession by one who would make the circuit of Monte Rosa. These lateral passes, though none of them difficult, are generally steep and fatiguing, and render this expedition a far more serious one than the circuit of Mont Blanc. There are usually several passes of these ridges: in the present case, having accidentally met with the curé of a parish which lay in the way of the pass to Ayas, we left Val Tournanche, in company with him, at seven o'clock A.M., and descended the valley a little way farther; we then took a footpath to the left, and soon found ourselves in a wood, which covers the precipices of that part of the valley. Our curé was a stout walker, and a useful guide, for our footpath (which was a *short cut*) soon split into numberless tracks, and as we gradually got amongst the rocks, we were glad that we were not left to waste

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time by discovering a way for ourselves. We ascended gradually higher and higher, and all the while, as we walked parallel to the course of the valley, the torrent was working itself deeper and deeper, so that from each fresh crag we found a greater interval between us and it, until at last, turning a rock, we stood above a precipice at least 2000 feet high, to which here and there a clinging pine seemed to give more steepness, by offering a scale for measuring the abyss. This point gained, we rejoiced in the beauty of the morning, and of the herbage spangled with drops from the early mists; and as we turned round we saw behind us the Mont Cervin rising in unclouded grandeur. We then passed from rock and wood to an open alpine pasturage, which seemed cut off by these precipices from the world beneath, and here was the home of our curé, a little village, appropriately named Chamoix, one and a half hours distant from Val Tournanche.

From thence, a gentle though pretty long ascent took us to the Col de Portala, composed of limestone, and very precipitous on the eastern side, where it immediately overlooks the village of Ayas. The height of the col, by M. Studer's observation, is 7995 feet, and that of Chamoix 6004 feet above the sea. The descent presented no difficulty, and from Ayas, two hours' pleasant walk took us to Brussone. In the course of it we crossed a singular tract of country. It was evidently the site of a lake which had been formed by the damming of the waters by a tremendous landslip which had taken place from a mountain on the right.

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At first we thought it a moraine, but we saw evidently that it was but a current of debris which had descended from the neighbouring hill, disengaged, like that of Goldau, probably by the force of water. The scale of it is immense.

We arrived at Brussone soon after three, and thought of going on to Gressonay, which would have been quite practicable. The beauty of the spot, however, tempted us to remain, notwithstanding the indifferent accommodation which the Lion d'Or offered; but, after all, we might have been much worse lodged. The village is beautifully situated on a frequented mule road from Chatillon to Gressonay, by the Cols of Ion and Ranzola; the lower part of the valley also communicates with the valley of the Doire, near Fort Bard. It appears, however, to be shut in by the highly picturesque mass of Mont Nery, a dark mountain, with snow lying in its higher ravines, and which, from its general character, is probably in geological relation with the mountains of Champorcher on the other side of the great valley.

The next morning was beautiful. It was Sunday, and as we slowly ascended the heights above Brussone, we met numbers of peasants descending to church, who greeted us in French patois. After two and a half hours, we reached the Col de Ranzola, which was higher than we expected, being 7136 feet above the sea, whilst the level of Brussone is 4431. It is a narrow opening in the ridge, from whence we suddenly obtain a view of the deep and narrow Val de Lys, and, soon after, of the village of Gressonay. As usual,

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(owing to the general western dip of the strata), the east side of the col is steep. Right opposite, we observed the Col of Val Dobbia leading from the Val de Lys to the Val Sesia. We ought to have enjoyed a view of Monte Rosa; but though the weather was fine, the mountain remained veiled in clouds. A rapid descent brought us, in about an hour, to the village of St. Jean de Gressonay, the principal place in the valley, where we at once perceived, by the appearance of the people in their Sunday costume, as well as their language, that we were amongst a new race. In fact the Val de Lys, and part of the neighbouring ones, are inhabited by a colony of Germans. We arrived at comfortable quarters, *chez* Luscos, in good time for the mid-day meal, and disposed ourselves to remain there for the rest of the day. Every thing betokened German neatness and order, and in a very short time, what appeared to us a sumptuous meal was set on the table, at which sat our host, himself the representative of one branch of the family of Luscos, one of the most dignified of the valley, and whose stately portraits, mingled with those of the reigning sovereigns of their time, graced the walls of the old baronial looking hall with huge stone-arched fire-place, and numberless windows in which we sat. The women, as usual, wore the more characteristic costume, and especially the caps of gold tissue, so common in some parts of Germany. The familiar language talked at table was German, though probably all the natives present could talk more or less French and Piedmontese. We were received with

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courtesy, and entertained less as guests at an inn than as at a private house, and we found that the charges bore a proportion to the favour thus conferred on us. Nevertheless, in such situations, a traveller is generally willing to purchase unusual comforts at a higher rate. An intelligent old man sat next M. Studer, and after a little conversation, he turned out to be M. Zumstein, the well-known ascender of Monte Rosa, whose acquaintance we had been prepared to make. He entered readily into conversation. When, after dinner, I handed him a letter which had been sent to me by the ever friendly care of the Chevalier Plana of Turin, he at once offered to devote himself to our service during our stay in the Val de Lys, and to accompany us to the glacier.

In pursuance of this plan, we proceeded next morning to Naversch, where M. Zumstein lives, forty minutes' walk above St. Jean, proposing to visit the glacier at the head of the valley, and to cross the Col d'Ollen to the Val Sesia next day. But the weather was too unfavourable. The clouds which had hung over Monte Rosa for two days now descended into the valley, and by the time we reached M. Zumstein's house, it rained heavily. We therefore paid him a long visit, and obtained some particulars respecting his journeys. His barometer, compared with M. Studer's, gave (29th August, 11 A.M.)—

	Fr. inch.	Lines.		Millimetres.
M. Zumstein's, .	23	7.8	=	640.5
M. Studer's, ...				640.4

Temperature of boiling water, (uncorrected,) 204° 20 F.

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In the afternoon, M. Studer and I walked down the Val de Lys about five miles below St. Jean. We quitted the green slates and serpentine, which are the prevailing rocks of Gressonay, and found hornblende slate with granite veins; the hornblende contains garnets, which are very characteristic of the mountains of Cogne, with which probably the Mont Nery is geologically connected. We also observed well-characterised *roches montonnées*, where the valley contracts into a narrow ravine, and its level suddenly falls. In general blocks transported from any considerable distance are rare in this valley. We returned to St. Jean to dinner, and M. Zumstein spent the evening with us. M. Studer resolved not to wait any longer for fine weather, and to cross at once to the Val Sesia. I was unwilling, however, to omit examining the glacier of Lys, and as our routes were to separate, at all events, very shortly, he keeping the southern side of the Alps, and I returning by Monte Moro into Switzerland, we determined, though with regret, to part here. The day was finer than the preceding ones, though clouds still lowered. M. Studer crossed the Col de Val Dobbia, whilst I reascended the valley to Naversch to join M. Zumstein, who good-naturedly accompanied me to the glacier, though the day was far from fine.

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CHAPTER XIII.

GRESSONAY—MONTE ROSA.

The German Valleys of Monte Rosa—Peculiar race of questionable origin — Their Manners and Dialect — Topography of Monte Rosa—Attempts to ascend it by Vincent and Zumstein —The highest point still unattained—An excursion to the Glacier of Lys—Its retreat—Its structure—Return to Staffel.

THE valleys of Gressonay, Sesia, and Anzasca, all in the Sardinian dominions, and to the south of the great chain of Alps, are inhabited, *in their higher parts only*, by a race of men whose physiognomy, dress, and language, alike bespeak a German origin. Were the heads of these valleys in immediate communication with those of German-Switzerland by easy passes, this would occasion little surprise, accustomed as we every day are to see national limits transgress natural or geographical boundaries, and the peculiarities of conterminous races to be softened by an imperceptible gradation. But in the Piedmontese valleys of Monte Rosa, the case is quite otherwise: the chain of Alps is their prison, not their portal; for from two out of three of them, no human foot has certainly ever passed directly from Italy to Switzerland, or the reverse. The German colony must,

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therefore, have been introduced through the Italian territory, and their choice, or their necessities, have driven them to the mountain fastnesses, which, perhaps, reminded them of those of their native land.

De Saussure has, as usual, nearly exhausted what it is of importance to say respecting the possible origin of these mountaineers. He has classed the existence of the German colony as one of the nine peculiarities of the district;* he has stated in a few sentences what may be conjectured as to their origin, and in a few more he has adroitly sketched their character.

De Saussure supposes that they were Valaisans who crossed the Monte Moro (a pass from the Val Anzasca into Switzerland) at a remote period, in order to occupy the higher valleys of Monte Rosa, whose rough surface and rude climate had repelled the more delicate Italians. He describes the people as simple, timid, and even rude, but honest; their greatest fault, a want of hospitality, which he found embarrassing at a time when inns were even rarer than at present.

It may be affirmed that the manners of the German settlers have improved since the time of De Saussure, which leads us to believe that their fault arose from their ignorance and isolation. I met everywhere with respectful, and even touching attention. Any traveller speaking the German language, is certain to be well received; and it is interesting to observe the tenacity with which these descendants of an unknown stock cling to the usages and the speech which form the only

* Voyages, § 2243.

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evidence of their birth, for history and tradition are both silent on the subject. Though most of the inhabitants—at least the men—speak several languages, acquired during their earlier years of expatriation, they invariably prefer speaking German, which many of them do with fluency, and without accent; far better, in short, than most persons of a similar class in German Switzerland. The expatriation to which I have alluded, arises from their practice of going forth from their valleys at an early age to push their fortunes in wealthier lands, and especially in southern Germany. But almost invariably, they at last return to marry,* and to settle in comfort at home. Hence, ease and independence is still more marked here than in Switzerland. Some of the earlier writers, as Scheuchzer, distinguish Gressonay as the "Merchant-Valley,"† *par excellence;* and at one time the race of pedlars in southern Germany were termed "Gressonayer" collectively.

Their habits are cleanly and active, and their houses, built in the true German taste, would alone, and at once, distinguish them from their Italian neighbours. I spent a Sunday at Gressonay, as already mentioned, which gave me an opportunity of seeing the holiday costume of the women, which resembles some of the gayest in Switzerland, especially the abundance of gold and silver lace, and the metallic helmet-caps. In reli-

* They have an expressive proverb to this effect:—

"Weiber und Steine muss man lassen wo sie wachsen."

† Krämer-Thal.

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gion they are strictly Roman Catholics: their churches are adorned with frescos in the Italian taste.

Since De Saussure called particular attention to the German settlers of Monte Rosa, several German authors have written respecting them. Of these the chief are Hirzel-Escher, Von Welden, and Schott. Of these works now before me, the last is the most elaborate as respects the question of population;* but it is tedious from its detail, and disagreeable to read, from an affectation of singularity in the spelling and printing of the German language.

Schott has given specimens of the patois of each of the various *communes* of the German valleys—namely, Issime and Gressonay in the Val de Lys—Alagna, the highest village, which alone is German, in the Val Sesia—Rima in the Val Sermenta—Rimella in the Val Mastalone—and Macugnaga in the Val Anzasca. That of Gressonay appears to be the least impure German; and indeed it is there alone that the striking externals of the German race are to be found in perfection: nearest to it in this respect is the valley of Anzasca. In every case, the patois is a corrupt mixture of Roman and Teutonic roots, of which the author has given an elaborate vocabulary. It is curious to observe, that in the proper names of these valleys, the family names have preserved pretty generally their German character, as Ackermann, Beck, Schwartz, Zimmermann,

* Die Deutschen Colonie in Piemont, ihr Land, ihre Mundart, und Herkunft. Von Albert Schott. Stuttgardt, 1842.

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Zumstein, whilst the Christian names are chiefly Italian.

The second of the works above named, that of Von Welden, is interesting from the topographical details which it gives of the complicated environs of Monte Rosa, which, till then, were very imperfectly understood, —and not less so from the details of successive attempts to reach its highest summit, made by M. Zumstein (a native of these valleys), and described in his own words.

The vexed question of the comparative height of Mont Blanc and Monte Rosa, was undecided before the survey of Von Welden, which was published in 1824.* It required an elaborate operation to determine its absolute height, on account of the complication of peaks of nearly equal elevation which form its summit, all of which cannot be seen from perhaps any point external to them, and which must nevertheless be separately and minutely observed, in order to ascertain which is really the highest. Thus De Saussure, as appears evidently from his own view (Voyages, Tom. IV. Pl. V.), measured not the highest peak, but only the third in height, now called the Zumsteinspitze. He made it 2430 toises, or 15,540 English feet above the sea.† This was within 200 feet of the height of Mont Blanc; but later and more precise observations all agree in making even the highest point considerably lower.

* Der Monte Rosa, eine topographische und naturhistorische Skizze. Wien, 1824.

† Voyages, § 2135.

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Von Welden finds it to be 14,222 French, or 15,158 English feet, which agrees nearly with the mean of the results of Carlini, Oriani, and Corabœuf.*

Monte Rosa is a union of several mountain chains, rather than one summit. The map, page 1, though on a small scale, will give an idea of their arrangement. From it, or from any map based upon Von Welden's, it will be seen that a vast inaccessible ridge stretches nearly east and west, commencing at the Col du Mont Cervin, between Zermatt and Breuil, and terminating in the Cime de la Pisse, to the east of Monte Rosa. This chain includes the Petit Mont Cervin, the Breithorn, and the Lyskamm. Another vast ridge, though a shorter one, meets this nearly at right angles, stretching from Monte Rosa northwards, towards the Cima di Jazi. It also crosses the chain to the south, so as to form the ridge of the Col d'Ollen between the Val de Lys and Val Sesia. The union or *knot* formed by these two chains is the locality of the elevated summits properly called Monte Rosa. Of course four cavities or angles are left when the transverse chain meets the longitudinal one. The one of these to the north-eastward, which is the most precipitous, and which, indeed, has been compared by De Saussure to a crater, forms the head of the Val Anzasca, and embosoms the glacier of Macugnaga; the north-western one, vaster, but less precipitous, gives

* Carlini,	2348 toises.	Von Welden,	2370 toises.
Oriani,	2388 „	Corabœuf,	2379 „

—*Brugière, Orographie de l'Europe*, p. 208.

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birth to the great glacier of Gorner, or of Zermatt; the south-western angle contains the glacier of Lys, which descends from the Lyskamm* into the valley of Gressonay; the fourth, or south-eastern cavity, is occupied by the head of the Val Sesia, and has also extensive, though less prominent glaciers.

Thus Monte Rosa is in ground plan like a four-rayed star or cross. All the highest summits are ranged along the northern and southern rays, especially the former. The point of union of the rays is not the most elevated, though, in some respects, it is the most generally commanding top. It is the most conspicuous from the Italian side of the Alps; it has been called by Von Welden "Signal Kuppe." It is the fourth in point of height. The three higher lie all immediately north from it; the first in order is the "Zumsteinspitze," the highest which has been ascended,† which is a snowy blunt summit, mistaken by De Saussure for the highest. Next follows the highest; a sharp rocky obelisk, well seen from the Col d'Erin (see page 224) and from Monte Moro (see next chapter). It is connected with the Zumsteinspitze by a longitudinal very sharp icy ridge like a house roof, which, on the eastern side, descends with appalling rapidity to an abyss which is scarcely equalled in the Alps for depth and steepness. Beyond the highest, or "Höchste Spitze," is the second highest, called by Von Welden "Nord-End," which, like the last, has never been scaled. The difference of height

* *Kamm*, a comb-shaped or jagged ridge of mountains.

† See note, p. 273.

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of these four summits is trifling, amounting to only 34 toises, or little more than 200 feet, from the highest to the lowest. Three other summits of somewhat less height form the southern arm of the cross, namely, the "Parrotspitze," "Ludwigshöhe," and "Vincentpyramide," the last of which, and also the lowest, was the first ascended of the group.

Having now endeavoured to give a distinct geographical idea of the position of this group of mountains (which I have seen and sketched in almost every direction from whence they are visible), I will add a very few words respecting the attempts which have been made to ascend it, which have excited far less interest than those upon Mont Blanc; and such is the confusion prevalent on the subject, that some guides of Chamouni maintain that they have ascended the summit of Monte Rosa from the Col of Mont Cervin, which is a good deal more ridiculous than if they proposed to scale Mont Blanc by ascending the Glacier of Argentière.

The explorers of Monte Rosa, in its wilder recesses, were MM. Vincent and Zumstein, the former the earlier, the latter the more persevering and successful. I can only mention briefly the results of their journeys, which may be found contained in an interesting series of papers by M. Zumstein in Von Welden's work.

The first ascent of the lowest summit was by M. Vincent alone, in August 1819, whence his name was justly given to it. Then he and M. Zumstein together repeated the ascent, with more favourable weather. The chief difficulties experienced were from a huge ice

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cleft, or *Bergschrund*, and from the labour of cutting 600 steps with a hatchet on a steep ice slope. The ascent on this, as on all other occasions, was made from the side of Gressonay, near the Col d'Ollen, where gold mines are worked above the limits of perpetual snow, and where, therefore, a shelter, however rude, could be obtained, at a height of 10,800 feet, certainly the highest temporary habitation in Europe.

The second journey, that of 1820, was performed by Zumstein alone, with the purpose of making for the summits farther to the north, and also the highest. He was accompanied by a surveyor, with a theodolite, who was commissioned by the Turin Academy to make observations for the improvement of the maps of Monte Rosa; but the Italian surveyor being unused to such excursions, the labour and expense of the journey were unavailing, although it clearly appears from the narrative, that had Zumstein himself been able to make the observations, he would have had ample time and opportunity for doing so,—one proof amongst many of the necessity (which De Saussure saw and acted on) of the director and chief of such an expedition being not only an experienced mountaineer, but himself capable of undertaking all the experiments and observations which he desires to be made. Under such circumstances, the zeal and sense of responsibility of the traveller and discoverer himself, are alone equal to the task of making observations of any value, or rather, not positively mischievous by their inaccuracy. The most perfect land-measurer, the most experienced laboratory assistant, are alike thrown out

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when they are expected to make their contacts, verify their zero points, record degrees, minutes, and seconds, with as much deliberation balanced on a dizzy pinnacle or exposed to a pinching frosty gale, as in their ordinary localities, and with the usual appliances.

M. Zumstein left the peak which he had before ascended, and several others, on his right hand, following the elevated snow valley which separates the high range of Monte Rosa from the Lyskamm. It appears that these vast snow-fields may be traversed without danger, unless from the chance of being overtaken by night or bad weather at so great a distance from shelter. The valley of Zermatt is visible from them; and we find that some peasants of Gressonay, who reached this point as early as the time of De Saussure, brought back startling reports of an unknown pastoral valley discovered by them amidst the wilds of Monte Rosa;* the fact being merely that they saw the woods and meadows of Switzerland, backed by the icy chains of the Col d'Erin, Dent Blanche, and Weisshorn.

So distant are the higher summits of Monte Rosa from the gold-miner's hut, whence the party had started in the morning, that the day was spent before the loaded guides and the timid surveyor could be got forward to the foot of the higher peaks. Here Zumstein had the courage to determine upon passing the night in a cleft of the ice at the height of 13,128 French, or 13,992 English feet above the sea,—undoubtedly the

* Compare De Saussure, Voyages, § 2156, and Zumstein, in Von Welden, p. 124.

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greatest height at which any one has passed a night in Europe.

The next morning, the summit bearing the name of Zumstein was attained without much difficulty. Here, too, the opportunity of making observations was lost, for whilst waiting for the ever tardy engineer, the horizon became clouded. The party perceived, however, that they were not, as they expected, upon the highest point, which was 750 yards farther north, and 200 feet higher. It appeared to them to be inaccessible in this direction. The barometer stood at 16⅓ French inches. None of the party experienced the exhaustion and other symptoms so often felt on Mont Blanc. They returned to the huts after having been forty hours on the snow. Twice afterwards, M. Zumstein repeated his visits to this peak, but without succeeding in making farther progress.*

I shall conclude this chapter with some account of an excursion in the valley of Gressonay, where we stopped at the close of the last chapter, in the friendly company of M. Zumstein, the mention of whose name naturally suggested this digression.

* Since the earlier editions of this work, the highest summit has been *all but* gained by the brothers Schlagintweit. According to the account I have seen, after scaling the reputed inaccessible rock which forms the conspicuous head of the mountain, they reached a point not many fathoms below the extreme pinnacle. This had already been done by a guide of the Sernfthal (Canton Glarus). In both cases the ascent was made direct from the Gorner Glacier (1854).

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The valley of Gressonay, or Lys-Thal, is more contracted and mountainous than I had expected to find it, and this is characteristic of several of the valleys which diverge from Monte Rosa, which seem to be mere cracks or rents without diverging branches of any extent. The sides are steep without being precipitously grand. Near St. Jean the valley is flat and fertile: at Castel, half an hour's walk above, it rises suddenly amongst rocks to a higher level. The distant view of Monte Rosa, which ought to be the centre of interest, was indeed wanting, for it remained impenetrably covered with clouds. Nevertheless, with M. Zumstein for my guide, I left Naversch, forty minutes' walk above St. Jean, for the glacier of Lys. At the hamlet of La Trinité, which is situated in the midst of a little plain, one hour from St. Jean, a small valley branches to the right, which affords the easiest road to the Col d'Ollen leading to the Val Sesia on the east. We continued a due northerly course, passing several cottages, which, though small, were clean and cheerful. In the lower part of the valley are many houses of considerable pretension, and at least three storeys high, which are all built of wood, and inhabited by the wealthier natives, who have returned with fortunes acquired in foreign countries, to pass the remainder of their days at home. Amongst these is Baron Peccoz, who acquired his nobility from the King of Bavaria, and who, having made money in trade in Germany, passes the greater part of the year at the very head of the valley of Lys, where he can indulge what is with him an insatiable

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passion for chamois hunting. His substantial dwelling is the very last permanent habitation in the valley, at a spot called *Am Bett*, and within half an hour's walk of the glacier. He entertained the sons of the King of Sardinia, and their suite, on a visit, which they made some years since to Monte Rosa. Having an introduction to him, through M. Plana's kindness, I might have availed myself of his hospitality, but he was absent upon his favourite sport, and M. Zumstein was good enough to secure for me humbler, but most comfortable quarters for the night, in the cottage of a worthy peasant of the valley. At a place called Staffel, the serpentine unites with the chlorite slate, and higher up is replaced by red gneiss. At a spot called Cour de Lys, are some traces of glacier action, namely, polished rocks, which, it has been observed, are rather rare in this valley. At Castel there are some blocks which appear to have been transported; but this evidence is doubtful where the geology is so monotonous.

At length we reached the glacier, at a distance of not more than two and a half hours' walk from St. Jean. It has retreated continually since 1820, and has left a vast enclosure—sharply defined by its moraine—a perfect waste, having (as I judged) not less than a square mile of area. Within this area is a kind of rocky precipice, above which the glacier has now retired; it is composed of gneiss, including quartz veins, and though these have never before been uncovered by the ice in the memory of man, M. Zumstein assures me that he has found marks of blast holes where metallic

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veins had been sought for, probably gold, which is still worked in the neighbourhood.

We ascended on our right the eastern moraine of the glacier, I mean its *ancient* moraine, which extends yet far beyond that of 1820, and with some labour and fatigue we gained the level of a kind of *plateau*, which intervenes between the crevassed ice descending from Monte Rosa and the final slope of the glacier, at its lower end. Here the view ought to have been very grand, but we were now completely in the clouds, with a drizzling rain. I wished to cross the glacier, in order to examine its structure, and a rise in the mist favoured us. The glacier stream is here composed of two great ice flows, derived from the two sides of a promontory, called *Die Nase*, or The Nose, and the eastern one is itself the result of two others, so that three streams of ice appear distinct where we crossed the glacier, with the usual belted structure, vertical near the sides, and under the medial moraine, and presenting a three-fold convexity in its front, as I have observed in other very wide glaciers, where the individual structure is not immediately lost. The bands were very well developed. I pointed them out to M. Zumstein, who candidly admitted, that much as he had been amongst glaciers, he had never noticed them before.

The moraines of the glacier de Lys are composed exclusively of gneiss and syenite, without a trace of green slate or serpentine, so abundant below.

Having crossed the glacier, we took refuge for a while from the weather in one of the rude cabins, con-

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structed by the shepherds, amongst the blocks of the ancient moraine. We then descended the west side; and I observed, in the moraine of 1820, several bands or heaps of stones, arranged transversely to the glacier, and parallel, like the ridges of a ploughed field. I am uncertain whether or not these were deposited in the *last* crevasses of the glacier before it disappeared.

We returned somewhat wet to the village of Staffel, and slept in the clean beds which had been provided for us. The guide whom I had desired to follow me from St. Jean to cross the Col d'Ollen next day, and to bring provisions, did not appear, and indeed the guides of this country seem to be not altogether sure. I ate cheerfully, however, the rye bread of the house, baked at Christmas 1841, and cut, with a hatchet, into morsels like sugar, of a size which could be put into the mouth at once. I found it not unpalatable, and even preferred it to fresh bread of the same kind.

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CHAPTER XIV.

TOUR OF MONTE ROSA CONCLUDED — FROM GRESSONAY TO VISP, BY MACUGNAGA AND MONTE MORO.

Passage of the Col d'Ollen—Alagna—Riva—The Col Turlo—Val Quarazza—Its polished rocks—Macugnaga—The people and their habitations—Excursion to the Glacier of Macugnaga—The Weiss Thor, a remarkable pass—Structure of the Glacier Glaciers of the second order—Geology of the chain of Monte Rosa—Pedriolo—Gigantic fragments of rock—Return to Macugnaga—Pass of Monte Moro—View of Monte Rosa—Descent to Saas—Glaciers of Schwartzberg and Allalein—Gabbro—Saas—Stalden—Peasants' Theatricals—Visp.

NEXT morning, after taking a cordial leave of M. Zumstein, I started soon after dawn from the hospitable roof of my entertainer at Staffel, with dull but fair weather, to cross the Col d'Ollen to Alagna, in the Val Sesia. A cheerful well-mannered peasant, named Joseph Skinoball, replaced my faithless guide as far as the col, whence he turned back. During the ascent we left upon the left hand the gold mines of Indren, and the spot named "Die hohe Licht," so often referred to in Zumstein's ascents of Monte Rosa. The Col d'Ollen might be reached either from La Trinité or from Staffel, or direct from the glacier of Lys. In

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fine weather it would not be too long a day's work to go from St. Jean to the glacier, and thence to Alagna or Riva, to sleep. The col is wild, and composed of jagged rock mingled with snow. I ascended in two hours and a quarter from Staffel. Water boiled at 195°.70, by the thermometer, whence I find the height to be 9758 feet above the sea. Keller makes it 1000 feet less.

From a little way beyond the col there is a fine view eastwards, including part of the Lago Maggiore and the hills beyond. The descent to Alagna is very steep and long (as it lies much lower than Gressonay), but, at the same time, interesting. The Val Sesia is here very narrow, and is included between two serrated chains of mountains, of which the Zuber, on the western, and the Taglia Ferro and Monte Turlo, on the eastern side, are conspicuous. The lower part of the descent to Alagna is through beautiful wood and green pastures. Alagna itself has a pretty church, in the Italian taste, and is most agreeably situated. I called on the curé, who had ascended the Signal Kuppe (one of the summits of Monte Rosa) a month before. Alagna is a very poor place. A much more barbarous German is spoken than at Gressonay, and it is so completely on the German boundary, that at Riva, only half an hour's walk further down the valley, Piedmontese is exclusively spoken, so that I was assured that a great part of the whole inhabitants of these two *communes*, especially the women, are incapable of understanding one another. There being no inn at Alagna, I descended the valley to Riva

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to sleep, although I should have to retrace my steps. I had, indeed, intended walking farther down the Val Sesia, which is more pleasing than the Val de Lys,—for I arrived at Riva before noon; but a violent thunder storm, which lasted all afternoon and part of the night, prevented me. The result, however, was happy. It put an end to the recent uncomfortable weather, and the wind having changed, some of the finest days of the season succeeded, commencing with the 1st September. It is a singular, and not unimportant fact, which every native of these valleys whom I consulted agreed in stating, that the N.W. and N.N.W. wind brings fine weather, and that the E. wind, which in Switzerland (and even at Courmayeur) is dry, is here the wet wind. M. Plana mentioned the same as being true at Turin.

The following morning I was up before daylight, and left Riva at a quarter past five. The weather was beautifully clear, and the summits of Monte Rosa showed finely, with the morning sun above the deep wooded valley. Riva is situated at the foot of the Col de Val Dobbia, and is, therefore, nearly opposite to St. Jean de Gressonay. The church contains some paintings of a rude kind. I had soon retraced my steps to Alagna, and there was introduced by the curé to a shepherd of Biella, who was going to cross the Turlo pass, and who offered to show the way. He was a merry fellow of the true Italian cast, with a broad brimmed hat, and spoke only the Piedmontese jargon. He had spent the night over the wine skin, and patheti-

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cally lamented the fatigues of the ascent, for which, indeed, he was not in very good training, and before we reached the top he declared himself to be "prope della morte." About three quarters of an hour's walk above Alagna, we passed an extensive establishment connected with a gold mine, the property of the Sardinian government; but, like most of the others in this neighbourhood, it has fallen completely into decay. The only gold mines which I believe are now worked to any extent are those of Pestarena, in the Val Anzasca. We crossed the stream soon after, and commenced the ascent of the Turlo. At a little height, Monte Rosa had a grand appearance, the chief summits visible being (as I judged by the map), Vincent's Pyramid, Ludwig's Höhe, and the Signal Kuppe. A steep zigzag leads to the higher châlets seated in an extensive hollow in the hill. From hence, a seemingly endless ascent over smoothish rocks mixed with turf, leads to the col, which remains in view the whole way. Monte Rosa is hid, and there is no variety of view. All travellers consider this, and justly, as one of the most tedious passes in the Alps, although it presents no kind of difficulty. The last part of the ascent is over fallen masses of rock. I observed a group of chamois to the right. The summit is marked by a cross. Here I found the temperature of boiling water to be by my thermometer 196°.68; that of the air being 36° at 11 A.M., from which I conclude the height to be 9141 English feet, instead of 8400 as marked by Keller.

The view from the Col Turlo is a wild one. The ridge

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is itself jagged and pinnacled in fantastic forms; on the eastern side, the ground falls (as usual) much more steeply, and the bottom of the Val Quarazza seems at an immeasurable depth, separated by an extensive snow field. Monte Rosa is still concealed by the mass of the Pizzo Bianco, which rises on the left. A very steep descent, first over snow, and then over fallen rocks, brought us, not without fatigue, down a height of several thousand feet. When we had reached the level of the highest sheep pastures, my guide took his leave; he gratefully accepted the trifle which I gave him for his safe conduct, and then he started off with the half-cheerful, half-plaintive exclamation,—"We shall meet no more but in Paradise;" and so we parted.

Not long after, I reached the châlets of Plana, which, like most of those in the neighbourhood, are inhabited by Piedmontese, and not by the German settlers, and consequently are very filthy. I rested awhile on the rocks between the châlets and the river, which were very beautifully rounded and striated, I have no doubt by glacier action. The forms were smooth, undulating ones, and the polish fine; the rock is a gneiss, approaching nearly to granite. I may mention that, in the Val Sesia,—that is, in the very small space of it which I traversed,—I observed no glacier marks on the rocks. In the higher part above Alagna, I noticed a very beautiful syenite in blocks; I also observed quartz-rock *in situ*, near the gold-works. Near the Col Turlo there occurs a beautiful mica slate, with crystals of schorl (which mineral I also found on the glacier de Lys),

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succeeded by a granitoid gneiss with large felspar crystals. The Val Quarazza, which is a tributary of the Val Anzasca, contains in its lower part granitoid blocks, probably transported by glaciers. I crossed the torrent a little below the châlets of Plana; the valley there becomes picturesque and wooded, and a series of cascades occur near the junction of the valleys. Turning to the left by the village of Isella, I reached Macugnaga about 4 P.M., having travelled very quietly. This valley is very pleasing in its appearance; the houses are dispersed over its surface rather than grouped in villages, but Macugnaga is the last commune. The people are agreeable, talking German; the houses neat, and the hay-harvest gave a lively appearance to the scene. For a while I could not get access to the inn, until the landlord, a decrepid, hunchbacked, and blind man, though still below middle age, made his appearance from labouring in the hay-field, and by his pleasing manner, and his attention, soon gained my interest, and made me well satisfied with what his house afforded, which, indeed, was more than average comfort, considering the remoteness of the spot. There was a visitor's book, and I do not think that a dozen travellers of all countries had entered their names since the previous year. The landlord's name is Verra, and his wife is an obliging person.

On the 2d September I rose at five, intending to cross the Monte Moro into the Vallais. The weather was superb, and Monte Rosa clear. Whilst I dressed I began to regret my purpose; and when I descended

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to breakfast, and got a view of the head of the valley of Macugnaga in all its magnificence, I called to mind that I had seldom, if ever, regretted a day's delay in the midst of fine scenery, and had often cursed the infectious haste of travellers. Therefore, although I had lost two days at Gressonay, I called my Savoyard, and desired him to prepare for a trip to the neighbouring glacier. We were soon on foot, with an enchanting morning; the sun was not yet risen on the valley, which had a freshness very symptomatic of fine weather, and which I had not enjoyed for some time; the north-west wind had established itself. A little above the village stands the church of Macugnaga, and beside it a noble and thriving lime-tree, forming an excellent foreground to the vast scenery behind, which is, beyond all comparison, the finest view of Monte Rosa itself. From thence I passed to the village of Pecetto, with its church, which is the last in the valley, and both here and at Macugnaga, I was struck with the unusual taste displayed in ornamental gardens at the cottage doors, and with the great beauty and luxuriance of some of the choice flowers, especially carnations. The inhabitants I met, and who greeted me in German, were chiefly females and old men. All the young men leave the valley to seek their fortune in France, or elsewhere, as merchants. The inhabitants of the Val Sesia are, in like manner, chiefly *colporteurs* or hawkers. This circumstance explains a curious remark of De Saussure, who, wishing to have a heavy case of minerals transported to Vanzone from Macugnaga, inquired

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for a man who could carry them. He was answered that no man in the valley was equal to the task, but that a *woman* could easily do it, if it was the same to him. And it is certain, he adds, that two women can carry a mule's burden.*

Beyond Pecetto a charming path lay through fields and woods, without habitations, but interspersed with barns; and the great glacier which occupies the head of the valley appears conspicuously. I ascended a steep wooded slope, which separates the lower end of the glacier into two, of which, however, by far the larger is on the right hand, the other being only a little overflow. This slope is very high and steep; the upper part is entirely composed of the ancient moraines of the glacier, which have a singular figure like artificial mounds, and embrace a charming well-watered pasture ground. From its upper part I crossed the main branch of the glacier on the right to the châlets of Jazi at the foot of the mountain of that name.† From thence the view of the precipitous amphitheatre of Monte Rosa and the Saasgrat is very fine. Nearly above these châlets I knew must be the celebrated pass of the Weiss Thor from Zermatt to Macugnaga. The Piedmontese shepherd who occupied the châlet could give me no information respecting it, and the range appears on this side so absolutely precipitous, that I could hardly convince myself that any track could be found accessible to human

* Voyages, § 2244.

† The Cima di Jazi appears to correspond with the Strahlhörner, when seen from Zermatt.

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foot. It is certain, however, that occasionally precipices are more practicable than they appear at a distance, and generally less vertical; and after a very careful examination, I detected a passage of the rocks, and only one, which it seemed possible to pursue. This pass is mentioned by almost every writer on Monte Rosa. De Saussure says that it is very dangerous, but does not state that he conversed with any one who had performed it.* In Hirzel† and Von Welden,‡ I find no particular addition from personal knowledge. Engelhardt§ relates the account of the passage of the Weiss Thor by his guide at Zermatt, no doubt Damatter, who has repeatedly assured me that he once passed it, that it is very dangerous, much more so than the Col d'Erin. Schott || states that this pass was formerly more used than at present, and almost exclusively for the purpose of pilgrimage from the Vallais to the Monte Sacro at Varese, and this corresponds accurately with what I learned from the host Verra at Macugnaga. It is pretty certain that it has been crossed but once in the memory of men now living, and then by a pretty numerous company. I believe that no one in the Val Anzasca has passed it.¶

I continued along the western moraine of the glacier for some way above the châlets, and crossed the foot of the first tributary glacier descending from the Monte

* Voyages, § 2145. † Reise, p. 32. ‡ Monte Rosa, p. 38.
§ Schilderungen, p. 195. || Die Deutschen in Piémont, p. 61.
¶ I believe that of late years the Weiss Thor has been crossed by at least one Englishman (1854).

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Rosa, or rather that part of it next the Weiss Thor called the *Nord End.* It has the usual scallop shell structure of steep glaciers. I then crossed to the centre of the glacier to examine its structure, and ascended the axis of it up to the limit of perpetual snow (or névé), having sent my companion to await my return on the eastern moraine.

The general structure of the Macugnaga glacier is quite normal, in single waves. Higher up, the glacier descends steeply on a twisted inclined plane, occasioned by the barrier which it has itself raised to its advance on the eastern side, by a stupendous moraine several hundred feet high, composed of huge blocks. The structure of the ice is beautifully developed as it sweeps round this spiral inclined plane, and is quite conformable to the cause which I have elsewhere assigned to it. Above this the glacier becomes more level. Its surface is thickly covered with snow, and this snow is evidently, in many cases, the result of avalanches which fall from the steeps of Monte Rosa upon the glacier, which De Saussure has stated to be one source whence glaciers derive their sustenance,—a fact which has been rather strangely denied. The snow, or névé, is usually disposed in bands or layers horizontally deposited, which most likely owe their origin to successive avalanches, or successive snow falls. I wish distinctly to state, that I attribute this stratification to nothing like the cause of the veined structure of glacier ice. I got some excellent sections of the glacier and névé together; the former underneath, presenting the usual vertical bands;

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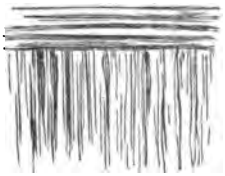
the latter superimposed in true horizontal strata. On the surface of the ice I found the remains of a gravel cone of vast extent. I mention this as a glacier phenomenon of rather unfrequent occurrence.



Superposition of the Névé on the Glacier of Macugnaga.

From the higher plateau, at the summit of a stupendous precipice, several thousand feet in height, to which the snow clings difficultly, is seen the principal range of summits of Monte Rosa; first, on the left, the *Signal Kuppe*, then the *Zumsteinspitze*, marked in De Saussure's view from Macugnaga as the highest. From this to the *Nord End*, a very considerable distance, there runs a sharp snowy ridge, which is broken at several points by projecting rocks; the first is a trifling pinnacle, but the second is a tremendous rocky tooth, the *Höchste Spitze*, or highest summit, which appears to join on to the snowy ridge before mentioned in such a way as to leave great doubt whether, even supposing the foot of it to be attainable, it could be ascended. East from the Signal Kuppe is a secondary ridge, connecting Monte Rosa with the Cime de la Pisse of Von Welden, and which, at the same time, separates the valleys of Anzasca and Alagna. From this several secondary glaciers descend, and have a short course, with great moraines. From the Cime de la Pisse the ridge turns N.E., and joins the Pizzo Bianco, ascended by De Saussure. I had an opportunity of examining undoubted specimens

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of rock, which had descended with the glaciers from different parts of the chain. From the highest ridge (*Zumstein-spitze* to *Nord End*), the rocks are a fine grained gneiss, and a beautiful silvery mica slate. This latter rock was shewn to M. Studer and myself at Gressonay by M. Zumstein, as the highest attainable one. From the Signal Kuppe and Montagne de la Pisse there descends a gneiss, with large felspar crystals such as I observed on the Col de Turlo. In general there is little chlorite, and no trace of serpentine or green slate, on this side of Monte Rosa.

I descended the steep moraine before alluded to, and at length perceived the smoke of a fire, which Tairraz had lighted below for his amusement. Nothing gave me so great an idea of the vast magnitude of the scene by which I was surrounded, as the difficulty of distinguishing a human figure, and the apparent insignificance of the blocks of stone, or, to speak more properly, fragments of mountains with which the ground at the foot of the moraine was strewed. These masses, which, as seen from a distance, lay in indistinguishable heaps, were, I am confident, the largest detached blocks of stone which I have ever seen in any position,—I mean, which had rolled, or been carried altogether from their native bed. That beneath which Tairraz had prepared our dinner was, I suppose, 500 feet in circumference, and it was 120 feet high. Since its deposition from lying on an irregular bed, it had broken through the middle, and left a serrated gap in the upper part. It was surrounded by several others scarcely less gigantic.

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These blocks are described by De Saussure, § 2144, and by Engelhardt, who discusses whether they were brought down by the glacier, and form part of the moraine. I incline rather to believe, that they fell from the slope of the Pizzo Bianco. The scene was beautiful, and interesting, and intensely solitary. These masses rest upon an alluvial well-watered flat between the edge of the glacier and the natural side of the valley. It is protected from the glacier by the vast barrier of debris already alluded to, which checks its progress, and, in fact, forms the little valley in question, which is covered with the most vivid green, and which forms the pasture or *Alp* of Pedriolo, the name of a few huts farther down, and already deserted for the season. With these stones as a foreground,—which, recalling past times and physical power, might be termed the Druidical monuments of nature,—the extent of glacier behind, and the chain of Monte Rosa in the distance, all seems harmonized to one scale of immensity, and the eye is satisfied.

I returned to Macugnaga by the track which leads over the rocks at a great height above the glacier, from the Alp of Pedriolo, and having passed two groups of wretched hovels by the way, I descended a steep and intricate path, which brought me back to that which I had left between Pecetto and the glacier.

The glacier of Macugnaga (called also *Anza Gletscher*, or the eastern glacier of Monte Rosa) appears to be as large as it has been for a long time: it has not shrunk like the glacier de Lys.

The following morning, at half-past five, I was on

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my way to the Monte Moro, the easiest passage of the great chain of Alps between the Great St. Bernard and

Monte Rosa from the Pass of Monte Moro.

the Simplon, but yet impracticable for horses or mules. Still it appears formerly to have been passed by beasts of burden, for there is a carefully constructed pavement visible at various parts of the ascent, especially towards the top, which has been noticed by De Saussure* and other writers, and which it is impossible to mistake. It is on record that this pass was in frequent use in the fifteenth and sixteenth centuries, and the road was maintained at the joint expense of the inhabitants of Saas and Antrona.† Although the absolute height of the Moro is greater than that of the Tufio pass, it is

* Voyages, § 2145. De Saussure seems never to have crossed the Monte Moro himself.

† Schott, page 63; Engelhardt and Venetz.

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incomparably less fatiguing, being both shorter and more interesting. Indeed, I could not refrain from turning round continually to admire the magnificence of the view of Monte Rosa, which, though the point of view never altered, seemed to rise to a greater height in proportion as I ascended. In four hours I gained the top, and having melted some snow, I observed the boiling point, which was 196°.30 by my thermometer, having been 205°.35 at Macugnaga the evening before. The temperature of the air was 41°. Compared with the barometer at Geneva and St. Bernard, the height of Macugnaga above the sea appears to be 4369 feet, and of Monte Moro 9641 feet.

The descent to Saas is singularly easy and pleasant. There is a steep bed of snow crossed at first, but afterwards a gentle fall leads the whole way down to Visp in the Vallais. On the right hand is the great chain of Alps stretching away towards the Simplon. On the left is the redoubtable *Saasgrat*, a lofty chain of inaccessible snowy peaks, separating the valley of Saas from that of Zermatt or St. Nicolas, and from which a series of glaciers descend into the former. There is said to be a passage from the one valley to the other from the top of the Findelen Glacier to the north of the Cima di Jazi or Strahlhorn, which must enter the Saaser-thal near Distelberg, the highest group of châlets. Damatter assured me, at Zermatt, that there is no other practicable pass across the Saasgrat.

I must say a word here respecting the maps of this country, which are worse than those of perhaps any

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other part of the Alps, and are all nearly equally bad, though with a great diversity of errors, which, showing that the artists have copied neither nature nor one another, leaves us to consider them as pure fabrications. Thus, in the map of apparently most authority of any—Von Welden's—attached to a work professedly geodetical and topographical, whilst the Italian side of the mountain and its valleys are neatly and well laid down, the northern or Swiss side is a mass of pure invention, in which the most obvious features are no where to be found, and villages and glaciers, lakes and mountains, are jumbled into inextricable confusion. Take the easily accessible neighbourhood of Zermatt;—the great glacier of Gorner is to be recognised only by its name, (Zermatt Gletscher,) and *debouches* on a lake which has no existence; the Riffel and the glacier of Zmutt are no where! Nor is the valley of Saas better. The Matmark See, a lake below Distelberg, is supplanted by an imaginary glacier, composed of tributaries from all sides, and across which the path of the Moro is carried. A very pretty and detailed map of the Simplon pass and its neighbourhood, published by authority, replaces the great glacier of Macugnaga by a great lake! Wörl, in his map, has copied Von Welden's errors. Even the new government map of Sardinia, of which a sheet has lately appeared, has perpetuated blunders even worse than Von Welden's, in exquisite engraving. Lakes are created, villages are displaced, and others which have no existence inserted where glaciers should be! The Italian side is, however, admirably executed,

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even though not quite precise in the details of roads and villages. On the whole, the most careful map of the Swiss part of the chain is that in Engelhardt's work;* but the author has unfortunately adopted a complex and impracticable system of projection, partly picturesque, partly geometrical, which greatly diminishes its value. I cannot help thinking, also, that in this, as in other maps, the breadth of the Saasgrat is underrated at its upper part. It is a very pretty, though certainly not an easy topographical problem, to unravel the complication of this chain, of which the mountains are so inaccessible, so varying in their forms, and each called by several different names.—But to resume the descent to Saas.

Four glaciers are passed by the way. The first is of small size, on the right hand, and near the pass. It is steep, but even, and exquisitely ribboned in the usual manner. The second glacier is on the left, descending from the summit called on the Sardinian map Monte Moro. It chiefly struck me, from the small stream of *pure* water which flowed from under it, as was also the case in the last glacier.

The third glacier is below the châlets of Distelberg on the left. It is called Schwartzberg. It is very remarkable, from its shrunk and wasted appearance. The limits of a moraine of recent date stretch quite to the eastern side of the valley (which is here wide), where it has left one enormous block of green slate, a cube of about sixty feet, slightly rounded on the

* Schilderungen der Höchsten Alpen, 1840.

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edges.* As far as I could learn from some peasants who were passing, this block was deposited about twenty years ago. The glacier has now retreated quite to the other side of the valley.

The fourth glacier, called Allalein, is the most remarkable of any. It completely crosses the valley (which is here rather narrower) with its moraine, which, damming up the river, forms a lake called the Matmark See. The moraine supplies the well-known blocks of gabbro, containing smaragdite, which are recognized so extensively over the plains of Switzerland, and which have no native locality in the Alps but here. They are brought down by the glacier from the inaccessible heights of the Saasgrat, which near this place rises to about 15,000 feet, so that the rock may probably never be found *in situ*. These masses are usually much rounded by attrition, notwithstanding their excessive hardness. The structure of the glacier of Allalein is well developed, and quite regular. It resembles generally the glacier of La Brenva in the Allée Blanche, and as in that case the river passes under it. It also resembles the glacier of the Rhone in the way in which it pours into the valley, and its consequent structure. The veined structure is especially developed *in front—i. e.*, against the opposing side of the valley, where the pressure is greater than laterally, and consequently the ice, seeking the direction of least resistance, is

* This is mentioned by De Charpentier (p. 41) under the name of the Blaustein; he describes it as deposited in 1818, and as having 244,000 cubic feet of contents.

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gradually swayed down the valley, and takes the particular form shown in the map, which, together with the sections, will give a clear idea of its whole structure. The direction of the crevasses is generally radial, or perpendicular to the structural bands. I walked over a part of the glacier, but it is not easy to advance far. The front of it is, as I have said, pushed by the general mass against the eastern wall of the valley. The rock, which is here soft, is disintegrated and clayey, and it was interesting to see that the glacier had left vertical markings or striæ upon the clay which had lately been uncovered by its melting, exactly as it would have done on rock, and in the very same direction as I observed them in similar circumstances against fixed rock at La Brenva.

Below Allalein the road falls more rapidly, and a very wild gorge is entered, which continues for a mile or two. The little village of Almagell is the first reached. Here a path on the right leads into the Val Antrona. In half an hour longer I was at Saas, where I received a hearty welcome from Moritz Zurbrücken, the worthy host in whose house I spent a night last year. The journey had been a short and interesting one, and its fatigues were soon forgotten over a roast leg of chamois and a bottle of good wine.

The neighbourhood of Saas presents one very interesting excursion, which I made in 1841, to the valley of Fée, which is a small branch of the Saas-thal, descending from the mountains to the west. The easiest ascent is by a footpath, exactly opposite to the

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village of Saas, and which is distinguished by a series of station chapels at intervals. The valley of Fée, like most of those in this neighbourhood, joins the principal valley at a higher level; and when that level is gained, the view is very striking. The entire head of the valley is bounded by a vast glacier, descending from the three lofty mountains, marked in Engelhardt's map, Schwartzhorn, Féehorn, and Stuffen, or Dom. The village of Fée, which is inhabited all the year, lies in a beautiful green hollow, amidst meadows and trees, which seem to touch the regions of ice. Indeed, a few years ago, the glacier descended so as to threaten the destruction of the higher châlets and trees, and completely to obstruct the passages to an *alp* or pasture between two branches of the glacier which then closed round it. About 1834, the glacier began to retreat, and has continued to do so since, so that it is now at a very considerable distance from the châlets, which it had almost touched. But what interested me most in the valley of Fée were the admirable traces of former glacier action throughout its length. *Roches moutonnées* of gneiss occur in the whole of the lower part of the valley, scooped out by horizontal grooves, perfectly continuous for some yards or fathoms, and which it is impossible to contend for a moment that water, however charged with stones, is capable of producing. Some of these grooves are like elaborate chiselling, and, on the whole, it would be difficult to find a better specimen of the phenomenon in question. It is remarkable, that in the valley of Saas, *above* the entrance of the valley of

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Fée, I perceived no such traces, which, however, appear at several points between Saas and Stalden. The rock of the higher valley, which is slaty and often friable, is certainly not favourable to the preservation of such surfaces. By continuing from Fée, along the western side of the valley of Saas, a beautiful walk may be followed through the wood, nearly as far as Almagell. The annual *fête* of the valley is held at Fée, on the 8th September.

From Saas to Stalden, there is a great variety of scenery; and in this respect the Saas valley is much more interesting than the neighbouring one of St. Nicolas. There is a series of green flats of small extent, separated by gorges of greater or less depth; one of these, in particular, about an hour's walk above Stalden, is extremely fine. The river rushes through a very deep, narrow chasm, overhung with magnificent larch trees, amongst the finest which I have seen in the Alps, and the head of the valley is closed by a snowy peak, perhaps the Monte Moro. It is also crossed by a little foot-bridge, upon which the traveller may stand to view the scene, if he wish to increase its sublimity by no visionary sense of danger in his own position; for the bridge is so weak that a heavy man might break it, and beneath is a furious torrent at a depth of perhaps 200 feet. The view *down* the valley is fine, as well as up; the Bietschhorn, a very elegant mountain north of the Rhone, stands in the opening. Where the valley of Saas is most contracted, the gneiss rocks, which form mural precipices, are striated horizontally to a great height—probably 800

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feet. Glaciers peep through the ravines on the western side, but none of them reach the valley.

Stalden is beautifully situated, as already mentioned, at the junction of the valleys of Saas and St. Nicolas. I had an opportunity of witnessing here a remarkable scene on my last visit. A comedy was to be acted by peasants dressed in costume, who were to perform on a stage erected in the open air. There were not less than forty actors, the female parts being performed by men, and the costumes were elaborately and ingeniously devised—in some cases not without propriety and taste. I was able to remain long enough to see only the opening of the piece named *Rosa von Tannenburg*, which was preluded by a procession of the actors, amongst the most conspicuous of whom were three devils attired in tight suits of black, with horns and tails, the senior wearing goat's horns, and the subordinates those of the chamois. The entertainment was under the immediate patronage, and even direction of the clergy. The morning mass at Saas was said that day at four, instead of five o'clock, in order to allow the pastor and his flock to reach Stalden in good time, and one of the *vicaires* of Stalden (who correspond to our curates) seemed to be the master of ceremonies, for he was frequently seen in earnest conversation with the junior devil with the chamois horns. I must add, that the scene was one of the most romantic which can be conceived. Behind the village was a truly natural theatre, with a green meadow for the pit, whilst a range of low cliffs, with a concave front festooned with ivy and brushwood, represented the boxes and gallery,

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and an audience of not less than two thousand persons, almost entirely peasants, with their gay costume, filled the allotted spaces. The sky was intensely blue, and the summits of the Weisshorn and other snowy Alps completed the picture.

I was obliged to withdraw sooner than I wished, in order to reach Visp in time for the diligence which was to take me to Sion. Thus closed one of the most interesting journeys which I have had the good fortune to make. Since leaving Orsières three weeks before, I had not even crossed a road which admitted of the passage of a wheeled carriage.

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CHAPTER XV.

PASSAGE OF THE COL DU TOUR.*

Glacier of Le Tour little Visited—Leave the Col de Balme—Ascend the Glacier—Its Features—Attain the Ridge—Its Unexpected Elevation—Exceeds the Col du Géant—Proposed as an Experimental Station—Descent on the Glacier of Salena—Fine Protogine—Topography—Difficult Route—Sudden Fog—Extrication—Reach Orsières in the Val Ferret.

HAVING learnt some years previously to 1846 the existence of a pass quite undescribed, and known to only one or two natives of the valley of Chamouni, communicating by the glacier of Le Tour to the Swiss Val Ferret, I attempted it in that year, but was foiled by bad weather. During a very hasty journey in 1850, I was more fortunate; and as the information I then obtained throws some new light upon the topography of this part of the chain of Mont Blanc, and as the excursion itself offers some interest, I now publish an account of it from notes made at the time.

The glacier of Le Tour is the only one of those descending into the valley of Chamouni which I had

* This chapter is reprinted from the author's "Norway and its Glaciers." It ought properly to have been inserted after Chapter V. of this volume, as it refers to the chain of Mont Blanc.

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not previously carefully examined. It descends in a wide, though not very imposing mass, immediately above the village of the same name, and occupies, for a long way, the right of the spectator who ascends from Chamouni towards the Col de Balme. It is lodged in a spacious valley, parallel to that of the glacier of Argentière, and to the eastward of it; it is commanded by the summit called the Aiguille du Tour to the east, and by the stately Aiguille d'Argentière to the west. Its general position amongst the mountains may be best judged of from the illustration opposite, which was drawn from a point pretty nearly due west of the glacier, being the summit of one of the aiguilles belonging to the range of the Breven, and behind the Col de Flegère, the height of the spectator being more than 9500 feet above the sea.* The extreme left of the figure shows the slopes between the glacier of Le Tour and the Col de Balme; and the rugged mountains immediately above form that part of the ridge which separates Savoy from Switzerland, and the basin of the Arve from that of the Trient, as well as the glacier of that name from the Glacier du Tour. As this last presents few noticeable features beyond its extent, having neither icy pinnacles, narrow gorges, nor a cavern comparable to the source of the Arveiron, it is little noticed by passing tourists, and is probably quite unvisited by them.

Having determined, however, to trace the glacier to

* 3140 above the Col de Flegère, by a good barometrical observation, 17th July 1850.

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The Glacier du Tour from the Aiguille de la Glière—Chamouni.

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its source, and, if circumstances allowed, to descend into Switzerland by the glacier of Salena, with which I understood that it communicated, I slept at the Col de Balme on the 19th of July 1850, in company, as usual, with my tried guide, Auguste Balmat. The weather proved so stormy, that I expected nothing but a repetition of the disappointment of my former attempt. But as it appeared to improve the following morning, we started, taking Michel Charlet, the tenant of the châlet on the Col de Balme, as a guide, (the route being as new to Balmat as myself) though it was already half-past eight o'clock, with the intention of at least exploring the glacier of Le Tour.

By sleeping at the Col de Balme, we have the immense advantage of starting from a level of nearly 7300 English feet above the sea. Walking first nearly on a level through the pastures towards the glacier, we soon began to ascend grassy steeps, in order to avoid the precipices which face the eastern side of the glacier of Le Tour. Having reached a certain height, we were compelled to descend a little, before gaining (at ten o'clock) the snow slopes, which still occupied the space between the moraine and hill side. These were next to be ascended, and in consequence of the extreme softness of the snow, the effort was fatiguing. At length, we got fairly upon the glacier, which (after attaining a certain elevation) continues to rise with much steadiness and uniformity, but was everywhere covered with tolerably soft snow. From the considerable elevation at which we first joined the glacier, we soon reached

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the level of the *névé*, and, keeping too near the centre, became involved for a time amongst its enormous chasms. From these we withdrew to the left without serious difficulty, and continued to traverse the snowy basin, which here attains its widest expansion, until we passed close to the small bare rock (called by the mountaineers *rognon*) marked *c′* in the sketch, page 303, at 12 h. 50 m. The chief part of the ascent was now accomplished, and we stood face to face with the Aiguille d'Argentière, which had a splendid appearance, being curtained with steep glaciers on its eastern side. We continued to advance steadily, but with labour, over the snow-fields, which still separated us from the rocky ridge of the Alps. Fresh snow lay to a considerable depth, and the hot sun rendered the effort of wading through it more fatiguing. But this was soon forgotten, in the pleasure of watching the summits, which gradually displayed themselves. Referring to the same sketch as before, *b* is the Aiguille du Tour; *c* is a snowy summit, overlooking the upper basin of the glacier de Trient, and is steep on the east side; *d* and *e* are pyramids of rock, forming the ridge of the Alps. That to the right (*e*) is a very beautiful aiguille, and is conspicuous from a distance. It is without a name.

The ascent continued, though more gently, from the *rognon* to the col between *d* and *e*, where we arrived at half-past one, five hours from the Col de Balme. The weather had still an unsettled appearance. Mists concealed many of the summits behind us, and also the more distant chain of the Great St. Bernard before us.

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The nearer peaks and glaciers were quite clear. The snow had drifted with violence into this ravine, and we took shelter from the force of the wind on a platform of rock a few feet below the level of the drift. The scene towards the Val Ferret was extremely grand. Immediately beneath us, a *very* precipitous slope of frozen snow covered the rocks on which we stood, overhanging the glacier of Salena, which lay some hundred feet below. This glacier fills a fine circus of wild rocks, of which the part A B *e d* E* (see the Plan on the next page) corresponds to the main chain, separating the glaciers of Argentière, Tour, and Trient, from those of the Val Ferret. The chain F of wild glacier-clad rocks separates this glacier from others, also descending into Val Ferret, whilst the chain M stretches towards the glacier and chapel of Ornex. The glacier of Salena is forced through the narrow gorge, bounded by the precipitous rocks H and L. A glance sufficed to shew the great difficulties to be experienced in descending the Swiss side.

Having reconnoitred our position, I proceeded to observe the barometer (a syphon, by Bunten) which stood at

$1^h\ 30^m$—505.2 millim.—Attached Ther. + 4° 0 Cent.—Detached, 30° Fah.

After a pause, I read again

504.3 millim.—0. 5 Cent.—Detached, 29° Fah.

* The position where we stood was between the summits *d* and *e*, which are denoted by the same letters both on the plan and sketch, page 303.

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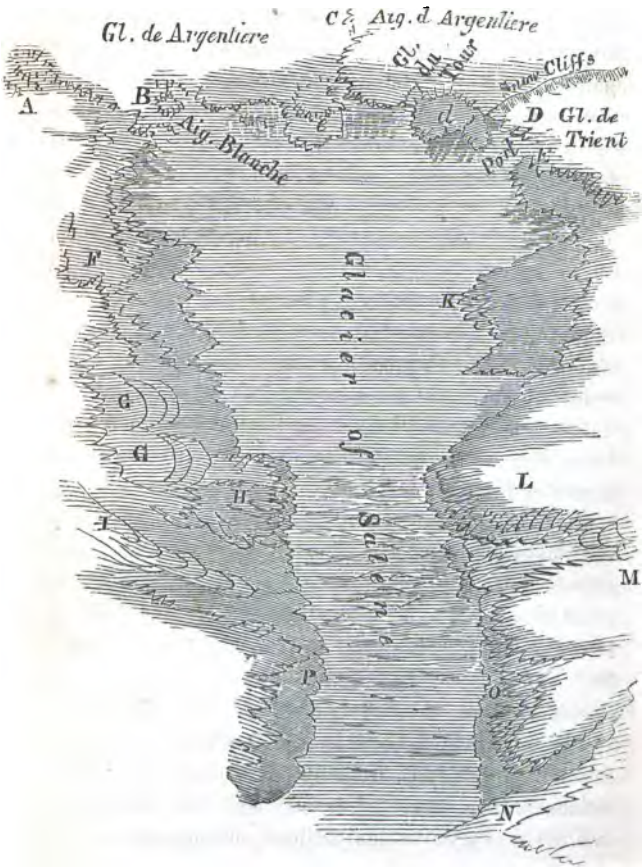

Plan of the Glacier of Salena.

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I immediately perceived that we were at a height equal, if not superior, to that of the Col du Géant. Subsequent calculation indicated 4044 feet above the châlet of the Col de Balme, which, from five comparisons made with the observatory of Geneva, is 7291 English feet, or 2220 metres above the sea—a result agreeing closely with the recent measurement by M. Favre, which is 2222 metres. Adding this result to the former, we obtain 11,335 English feet for the height of the granitic axis at the lowest point between the glaciers of La Tour and Salena on the side of the Swiss Val Ferret. By a single direct barometrical comparison with Geneva,* I obtained 11,284 English feet above the sea, or 140 feet higher than the Col du Géant, and nearly 1200 feet higher than Mont Buet, which lies towards the north-west, exactly in the prolongation of the axis of the glacier of Le Tour.

This unexpected result suggests some interesting considerations. There are few spots of the same elevation so easily accessible, and it is unquestionable that some of the numerous peaks which rise from this lofty platform could be ascended without risk, to a height of some hundred feet more. The rocks hemming in the glacier present shelter against the severity of the terrific gales which blow at these altitudes. An observer might be stationed here for meteorological observations, with a degree of security and ease which Saussure never enjoyed in his perilous encampment on the

* The barometers were carefully prepared by Professor Plantamour, at Geneva, a few days later.

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Col du Géant. Provisions could be regularly obtained from the elevated station of the Col de Balme, which is within a walk of which a mountaineer thinks little, and devoid of danger. Even the extent of surface which the mountains here present at so great a height, is itself very favourable to several kinds of observation.

I have called the fact of the great elevation of this part of the chain of Mont Blanc unexpected, both because it was entirely so to myself, and because the existing maps and models gave an entirely different idea. Even the admirable model of M. Séné, which I inspected soon afterwards at Geneva, shows a rapid depression in this part of the ridge, which indeed might have been imagined from the rapidity with which it dies out altogether in the space of a few miles in the direction of Martigny.

The temperature of the air, as we have seen, was three degrees (Fahrenheit) below freezing. As we turned round and, facing the north wind, clambered from under the sheltering snow drift, we first perceived its biting coldness, and at the same moment the strong draught of air setting through the gorge, nearly detached all our hats in a moment, and actually carried Balmat's over the precipice down to the glacier of Salena. We were then struck, whilst looking in each others faces, at the pinched and ghastly appearance which all presented. Both the guides looked nearly bloodless; but none of us felt unwell. We took some brandy as a precaution (probably a needless one) against the cold, and tied our handkerchiefs over our ears. Charlet now told us that when here twelve years before, he had succeeded in

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descending on the glacier of Salena by turning round the north side of the peak *d*, (which is partly of rock, partly of snow, and appears to be accessible) in the direction of the glacier of Trient. In following this course, we passed between the summits *c* and *d*, and gained a point somewhat higher than the barometrical station. From D we had a view of a new glacier, or *nĕvé*, which Charlet told us (and it is no doubt so) communicates with the glacier of Trient. It was by descending upon this first that he had gained the level of the glacier of Salena afterwards.

The question now was, should we retrace our steps to Chamouni, or push on to Orsières? Charlet feared that our non-appearance at Col de Balme or Le Tour might create uneasiness; but after some discussion it was agreed that the opportunity of proceeding was too tempting to be lost, especially as the weather appeared fine towards Val Ferret. After scarcely a minute's delay, then, we resolved to seek a safe place of descent to the level of the névé connected with the glacier of Trient, which we had to effect over an almost precipitous surface of hardened snow (presenting in some places an *overhanging* edge of alarming appearance), but which admitted of a passage at one point with little difficulty or danger. This snow cliff scarcely existed when Charlet formerly passed—an instance of the great changes undergone by the glacier regions. Being now on the level of the névé, we turned towards the right hand, and found a wall of rock cut through by a magnificent gateway, flanked by two pinnacles of highly crystalline

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protogine not many yards asunder, between which we passed with the greatest ease, and, descending a snow slope of no great height, we found ourselves on the névé of the glacier of Salena. The abruptness of the change and the beauty of the portal (like the *ports* of the Pyrenees, but still narrower) rendered this a very striking and peculiar pass. The basin in which we now found ourselves is remarkably enclosed by precipitous rocks, everywhere interspered with glaciers and perpetual snow. Our station between the peaks *d* and *e* now appeared at a great height above a most precipitous snow slope, toward which Auguste long and wistfully looked for his lost hat. Behind the peak *e*, to the westward, it appeared as if a passage might lead from the glacier of Le Tour to that of Salena, but Charlet assured us that he had formerly explored the glacier of Le Tour and found no exit in that direction. It appeared to us not impossible that a pass might exist from the head of the glacier d'Argentière directly to the glacier of Salena, between *e* and the very white summit marked Aiguille Blanche; but my recollection of the glacier d'Argentière is not favourable to this idea. Charlet strongly insisted that the glacier d'Argentière does not terminate behind the Aiguille Blanche, as I thought, but, bending, stretches to the S.W. behind the summit A, which I rather conjectured to be the summit seen to the S.E. of the Jardin, and marked in my map of the Mer de Glace.

The névé of the glacier of Salena, seen from the point, or rather the snowy basin at which we were now

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arrived, might well appear to have no issue. The formidable barriers of rock, between which the glacier descends almost precipitously, might seem to bar a passage in the direction of the valley. From Mugnier's account (the guide of Chamouni, whom I engaged in 1846 for this excursion), it appears certain that he did not attempt to descend (his words to me I recollect, were, "Nous n'avons pas osé de déscendre"); but he had preferred crossing the lofty range somewhere about F by which means he arrived at the glacier of La Neuva, by which he descended near the Col Ferret. Trusting, however, to Charlet's report of what he had actually done (for the advancing afternoon left us no time for abortive attempts), we resolved to descend as much as possible by the glacier de Salena. We accordingly secured ourselves once more together by ropes, and soon came amongst newly opening crevasses as we approached the gorge which offered the great obstacle to our passage. We resolved to retreat to the left bank of the glacier, and to dine on the rock at K, near abundant streams of snow water descending from a glacier connected with the heights above us on the left, amidst a perfect chaos of stupendous blocks of the finest granite, or rather protogine, anywhere to be seen in the Alps. This was at 3h. 10m.; at 3h. 45m. we were ready to start, and again used the ropes for a short space, but, soon clearing the snow, we abandoned them, and following for a little way the left bank of the glacier, as it got steeper and steeper, and began to break into wider crevasses, Auguste volunteered to go on and see whether

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it might be possible to effect the descent over the broken ice. As we more than anticipated, however, he returned to say that it was quite impracticable, and that, therefore, we must submit to clamber over rocks to a great height above the right bank, and to pass beneath the small glaciers G G, which was not unattended with danger, in event of stones rolling from them. We first crossed the main glacier without much difficulty, and could now inspect those small glaciers of the second order, which seemed almost to overhang the path we must follow, so steep was the mound of debris which stretched from their foot. We could distinctly see stones on their upper fronts, but the guides pronounced them apparently safe, and recommended the precaution merely of mounting the slope of debris, and slanting over to the shoulder of rock H as rapidly as possible. It was a fatiguing but a short effort, and the risk I should say was inconsiderable, at least in the then condition of these glaciers. The summit of the rocky shoulder H was strewed with enormous blocks, tossed in confusion, shattered and bruised by the mutual shocks which they had evidently undergone no further back than last spring, when they had thundered down with the early thaw, from the upper level of the little glaciers. At present, however, there was no danger, and we paused a while for breath.

We were now at a great height above the glacier of Salena, not only on account of the ascent which we had made, but also from the steep fall of the glacier in a contrary direction. Having passed the summit of the

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knoll which had formed the great obstacle, we were now to seek a safe descent to the main glacier once more. This would have been, in all probability, a matter of small difficulty, had not the fogs which all day had been hovering on the summits, suddenly descended at 5 p.m., and enveloped us almost without warning. Our position was not free from anxiety, for it was impossible to see more than 30 or 40 yards in any direction. Charlet continued to advance until we found a small steep glacier in front of us, descending from the heights above, and completely barring passage in a forward direction—(it is shewn at I in the sketch, p. 307). We then attempted to descend the rocky ridge upon which we found ourselves, which fell steeply towards the main glacier, but a moderate distance brought us to impracticable precipices. In these circumstances, only two courses remained open, either to wait for the rising of the fog, or to descend from the rock upon the moraine and rubbish which bordered the small glacier, and then attempt to scramble down it. We followed the latter course, and our descent was facilitated by long snow inclines, over which we slid rapidly; whilst so engaged, the fog happily cleared for a few minutes, revealing our entire position, and giving us an opportunity of resolving on our ultimate route, for we knew that sooner or later we must cross the main glacier. Fortunately we had selected what appeared to be the *only practicable descent.* On the one side of us was an impassable glacier, on the other impassable cliffs. Having made very rapidly a great descent, we diverged to the right, passing (at a safe distance) under

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the termination of the small glacier, and soon after reached the level of the glacier of Salena without difficulty, which we also crossed with no great delay. We had then a tedious descent over rough moraines, here and there diversified by patches of the most superb vegetation, till we came to a torrent which we understood to descend from the glacier of Ornex, where we halted for a short time at 6h. 45m. This stream we also crossed without difficulty, and had now reached the limit of trees; we had a stony and laborious descent through woods nearly pathless before we came to a certain track. By this time we had passed the termination of the glacier of Salena, which we saw distinctly below us. Amidst the wood were vast blocks of the granite of Ornex, and, looking back, fine views of the glacier we had left; but the mists were *again fallen below the level of the place of our perplexity*, so that, but for the momentary rise, we must have remained in much anxiety. At 7h. 55m., we reached the village of Praz de Fort, in Val Ferret, close to the remarkable moraine which protrudes into the valley, and which attracts the attention of all travellers. An hour's sharp walking brought us to Orsières, which we entered at 9 p.m., 12½ hours from the Col de Balme.

The junction of protogine and gneiss, on the north side of the glacier, appeared to be not very far above our ingress on the glacier of Le Tour. On the south side, the gneiss formation is comparatively narrow; I did not notice the junction accurately, being too happy

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at our escape from the fog to think of anything else; but I believe that it was near the point where we crossed the glacier of Salena after our rapid descent. The calcareous schists appeared in the wood on our left, some time before reaching Praz de Fort.

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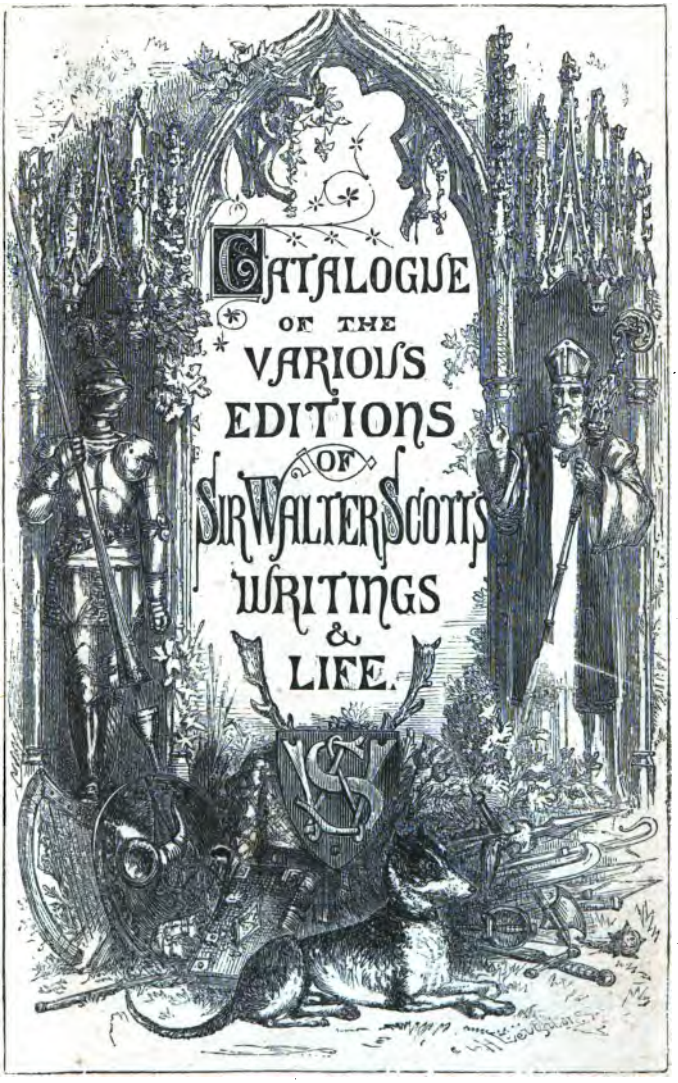

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